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THE ENGINEER, FEBRUARY 27, 1925.

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXXXIX.—No. 3609] LONDON: FRIDAY EVENING FEBRUARY 27, 1925 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 13, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :

1. STEEL DIVISION PLATES for INDIA-RUBBER SPRINGS for COVERED WAGONS.
2. LATHES, COMBINATION TURRET, Herbert No. 3 and No. 9, or similar.
3. LOCOMOTIVES, No. 14.
4. RAILWAY GOODS BRAKE VANS, No. 13.

Tenders due on the 10th March, 1925, for No. 1, on the 17th March, 1925, for No. 2, and on the 20th March, 1925, for Nos. 3 and 4.

Tender forms obtainable from above. 8511

Civil Engineer Required by the GOVERNMENT of CYPRUS for the PUBLIC WORKS DEPARTMENT for three years' temporary service. Salary £400 a year. Free passages for officer selected and, if married, for his wife and family. Candidates, not over 35 years of age, should have passed the examination for the A.M.I.C.E. or A.M.I. Mun. and Cy. E. or hold equivalent professional qualifications and have a good knowledge of building work and road work, and must be good draughtsmen.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/13,389. 8501

Civil Engineer Required by the GOVERNMENT of ZANZIBAR for a tour of 20 to 30 months' service. Salary £400, rising by annual increments of £20 to £500 a year and thence by annual increments of £25 to £600 a year. Free quarters or allowance in lieu. Free passages and liberal leave on full salary. Outfit allowance of £90 on first appointment. Candidates, aged 25-35, must have had good practical experience as civil engineers on roads, buildings, and other public works, and preferably should have passed the examination for A.M.I.C.E. or hold equivalent professional qualifications.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/13,390. 8497

NOTICE OF MISREPRESENTATION.

The Central Argentine Railway, Limited (Head Office, 2a, Coleman-street, London, E.C. 2), hereby to notify ALL WHOM IT MAY CONCERN that a PERSON who describes himself as "FRANKLY" or "F.L." "NEHER" is UNKNOWN to the COMPANY, and it follows that he is entirely without any authority to invite or receive Tenders for any goods on behalf of the Company or in any way to represent himself as an Engineer of or holding a position in any other capacity in connection with the Company. The Company regrets to find that the person named should have misled certain firms in Belgium by his misrepresentations. 8460

Auckland University College, NEW ZEALAND.

The High Commissioner for New Zealand has received a cabled notification from the University Authorities CANCELLING THE REQUEST for APPLICATIONS to be invited for the POSITION of LECTURER IN CIVIL ENGINEERING, which position was advertised in the issue of this journal for February 20th. 8412

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 13th March, TENDERS for the SUPPLY of :—

1. TYRES FOR CARRIAGES AND WAGONS.
2. AXLES FOR CARRIAGES AND WAGONS.
3. WHEELS AND AXLES FOR BRAKE VANS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for No. 1 and 10s. each for Nos. 2 and 3 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices : 91, Petty France, Westminster, S.W. 1.
25th February, 1925. 8498

City of Hull Waterworks.

The Corporation are prepared to receive TENDERS with full particulars for the PROVISION and ERECTION of FOUR HIGH-PRESSURE STEAM SUPERHEATERS of British manufacture, at the Springhead Pumping Station.

Details and particulars, &c., may be obtained from the undersigned.

Tenders, endorsed "Superheaters," are to be addressed to the Chairman of the Water and Gas Committee and delivered at the Town Clerk's Office not later than Marca 13th, 1925.

By Order,
O. B. NEWTON,
City Water and Gas Engineer.
February, 1925. 8486

Corporation of Harwich. FACTORY SITE.

The Corporation are prepared to LET on a Long or Short Lease a SITE eminently suitable for a factory.

The site is situate in Devereourt and includes a chimney 250ft. in height.

The site abuts upon the railway and River Stour and the lease would include the right to use the dock in the immediate vicinity.

Area about two acres.

Further particulars can be obtained from the undersigned.

A. J. HANSLIP WARD, Town Clerk.
Harwich, 20th February, 1925. 8458

County Borough of Stoke-on-Trent ELECTRICITY DEPARTMENT (CONTRACT NO. 2508.)

TENDERS are INVITED for :—

STEAM PIPING, with WELDED FLANGES, VALVES, STEAM TRAPS, &c. (Section 1).

WATER PIPES, VALVES, &c., of CAST IRON (Section 2).

Tender forms and specifications obtainable from Borough Electrical Engineer, St. Peter's Chambers, Stoke-on-Trent, on deposit of £2.

Tenders to be delivered March 10th, 1925, to
E. B. SHARPLEY, Town Clerk.
Town Hall, Stoke-on-Trent,
February 23rd, 1925 8470

The Engineer

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The British Steam Railway Locomotive from 1825 to 1924—No. 9.

New Dock Equipment on the Clyde—No. I.

Report on New Zealand Railways.

The British Industries Fair—No. II.

Proposed Submarine Tubular Railway.

Electricity in Mines.

Four-Cycle Marine Oil Engine.

An Extra-High Pressure Boiler.

PUBLIC NOTICES

Barking Town Urban District COUNCIL.

OFFERS are INVITED for a SECOND-HAND No. 4 PORTABLE FULSOMETER PUMP and BOILER as it lies at the Council's Yard, East-street, Barking.

The pump can be inspected on application to the Council's Storekeeper, Town Yard, East-street, Barking, Essex, on any weekday between the hours of 7.30 a.m. and 4 p.m., and on Saturdays between 9.30 a.m. and 12 noon.

Form of Offer may be obtained upon application to the Engineer and Surveyor to the Council, Public Offices, East-street, Barking.

Offers are to be forwarded, in the special envelope provided for the purpose, so as to reach the Engineer and Surveyor not later than 9.30 a.m. on Friday, the 13th March next.

The Council do not bind themselves to accept the highest or any Offer.

By Order,
H. HARGREAVES,
Clerk to the Council,

Public Offices,
Barking, Essex.
23rd February, 1925. 8480

London and North-Eastern RAILWAY.

The Directors are prepared to receive alternative TENDERS for the SUPPLY and ERECTION and SUPPLY only of STEEL WORK for the Renewal of Seven Bridges on the Riverside Branch, Newcastle. The contract comprises amongst other items about 161 tons of steel work in troughs and decking, riveted up, painted, &c., as described in the specification.

Drawings and specifications may be seen and detailed quantities and forms of Tender obtained on personal application at the office of the Engineer, North-Eastern Area, York.

Sealed Tenders, marked "Tender for Seven Bridges, Riverside Branch, Newcastle," must be received by the Joint Secretaries, L. and N.E. Rly., Marylebone Station, London, N.W. 1, by 9 a.m. on 16th March, 1925.

The Directors do not bind themselves to accept the lowest or any Tender.

JAMES McLAREN,
G. F. THURSTON,
Joint Secretaries.

Secretary's Office,
Marylebone Station,
24th February, 1925. 8500

Metropolitan Water Board. PROVISION OF 5 TON STEAM CRANE—BATTERSEA.

The Metropolitan Water Board invite TENDERS for the SUPPLY, TESTING and SETTING to WORK of a STEAM-DRIVEN LOCOMOTIVE SHUNTING JIB CRANE of 5 tons capacity at their works in Kirtling-street, Battersea Park-road, S.W.

Tenders must be made on the official forms, which may be obtained on and after Thursday, 19th February, 1925, from the Chief Engineer, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1, by personal application (Room 156) or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Crane," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Tuesday, 3rd March, 1925.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
17th February, 1925. 8419

PUBLIC NOTICES

The Derwent Valley Water BOARD.
PIPE TO FILTERS.

The Derwent Valley Water Board is prepared to receive TENDERS for the LAYING of about 10,000 YARDS of 48in. STEEL PIPES, lined with Concrete, and the VALVES, STEAM CROSSINGS, &c., connected therewith.

The specification and schedule of prices and copies of the drawings may be obtained on application to Mr. S. B. Wilson, M.I.C.E., Engineer to the Board, at these offices, on and after Monday, 9th March, on payment of Two Guineas, which will be returned on receipt of a bona fide Tender and the documents furnished by him.

Sealed Tenders, enclosed in the envelope supplied with the documents, to be delivered not later than Nine o'clock on Monday morning, the 23rd of March.

The Board will not be bound to accept the lowest or any Tender.

O. B. STEWARD,
Clerk to the Board.

Bamford, near Sheffield,
23rd February, 1925. 8495

The Great Indian Peninsula RAILWAY COMPANY, 48, Copthall-avenue, E.C. 2, invite TENDERS for :—

VERTICAL BOILERS .....For Rs.

Tenders are due by 11 a.m. on 10th March, 1925. Tender forms obtainable at above address. Fees not returnable. 8499

Urban District Council of HAVANT (HANTS).
EXTENSION OF MAIN DRAINAGE WORKS OF HAVANT.
UNEMPLOYMENT RELIEF WORKS.
GENERAL CONTRACT No. 2.

The Urban District Council of Havant invite TENDERS from responsible and experienced contractors for the CONSTRUCTION of the WORKS, which comprise Stoneware and Cast Iron Sewers, Brick, Concrete and Cast Iron Manholes, Cast Iron Rising Main, Underground Pumping Station, Pumping Plant, &c., and other incidental works.

A copy of the specification may be seen and form of Tender and bills of quantities may be obtained on application, in writing, to Major T. J. Moss-Flower, Chartered Civil Engineer, 28, Victoria-street, Westminster, S.W., and Carlton Chambers, Bristol, at his Bristol Office, on and after the 24th February, 1925, on deposit of a £5 Bank of England Note, which will be refunded, provided a bona fide Tender be received, and is not withdrawn before the sealing by the Council of one of the Tenders, and provided also that all documents supplied be returned to the Engineer. On production of a receipt for the deposit persons tendering may inspect the plans at Havant on a day and at a time and place which will be communicated to them.

The contractor carrying out the work will be required to comply with the regulations of the Unemployment Grants Committee with regard to the employment of labour during the performance of the contract.

Sealed Tenders, endorsed "Tender for Havant Main Drainage Extension, General Contract No. 2," are to be delivered at the Council offices not later than Noon on 14th March, 1925.

The lowest or any Tender will not necessarily be accepted, and the carrying out of the work is subject to the approval of the Ministry of Health and the Unemployment Grants Committee.

Dated this 17th day of February, 1925.
(By Order),
E. R. LONGCROFT,
Solicitor and Clerk to the Council.

Council Offices,
Havant, Hants. 8379

PUBLIC NOTICES

Royal State Railways of Siam.

Sealed TENDERS for the SUPPLY of BOGIES and UNDERFRAMES for BOGIE CARRIAGES B.E. 2468 will be received by the undersigned at his office up to Fourteen o'clock on Monday, the 1st June, 1925, at which place and hour the Tenders will be publicly opened and read.

Blank Tender forms, specifications and plans may be obtained from Messrs. C. P. Sandberg, 40, Gresham-gardens, London, E.W. 1, upon payment of £1 10s. per set, which sum will not be refunded.

Right is reserved to reject any or all Tenders and to accept any Tender which in the opinion of the undersigned is to the best interests of the Royal State Railways.

The Royal State Railway Department.
PURACHATRA,
8474 Commissioner-General.

HUMBERSTONE AND EVINGTON, NEAR LEICESTER.
MAIN DRAINAGE WORKS.

The Billesdon Rural District Council are prepared to receive TENDERS for the CONSTRUCTION of about 11,000 YARDS of 7in., 9in., 12in., and 15in. STONEWARE PIPE SEWERS, together with MANHOLES, VENTILATION SHAFTS, and other WORKS required for the drainage of the parishes of Humberstone and Evington, in the County of Leicester.

The contract is divided into three sections, of which the first section, comprising roughly one-third of the work, will be carried out with labour obtained in the usual way in the open market, and the other two sections with labour provided through the Labour Exchange under the conditions laid down by the Unemployment Grants Committee.

It is a condition of the grant from the above Committee that an active start is made with the work by March 31st, 1925, and that the work at Evington is completed within eight months and at Humberstone within nine months of that date.

The drawings may be seen at the offices of the Engineers, Messrs. Pick, Everard, Keay and Gibson, 6, Millstone-lane, Leicester, from whom conditions, specifications, quantities and form of Tender may be obtained on payment of £2 2s., which sum will be returned on receipt of a bona fide Tender.

Sealed Tenders, on the form supplied, must reach the undersigned not later than Ten o'clock in the Forenoon of Friday, the 20th day of March, 1925, endorsed "Tender for Humberstone and Evington Drainage."

The Council do not bind themselves to accept the lowest or any Tender.

W. E. RICHARDSON,
Clerk to the Council.
18, New-street, Leicester. 8510

The Urban District Council of ABERDARE.
FOR SALE.

Due to the closing down of Refuse Destructor Station, the Council invite OFFERS for ONE 200 K.W. and ONE 100 K.W. DIRECT-CURRENT STEAM GENERATING SET.

Full particulars will be supplied on application to the undersigned.

W. T. HILDER, M.I.E.E.,
Engineer and Manager.
Electricity and Tramways Dept.,
Aberdare, Glam.
15th February, 1925. 8463

Singapore, Straits Settlements. WATER DEPARTMENT.
ASSISTANT ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT WATER ENGINEER, age 25-30, unmarried, on a four years' agreement, with possible extension. He must have had a good technical education, a regular training as a civil engineer, and have a practical knowledge of surveying, levelling, and estimating, and at least three years' experience in works of water supply. Preference will be given to an Assistant who has passed the examinations of the Institution of Civil Engineers as Assoc. M. Inst. C.E. The Testamur by examination of the Institution of Municipal and County Engineers will be an advantage.

Salary 5400 dollars for the first, 5700 dollars for the second, 6000 dollars for the third, and 6300 dollars for the fourth year, paid monthly in dollars, the currency of the Colony, the value of the dollar being two shillings and fourpence sterling. The pay of the appointment for the first year at this rate would be £630. Such local transport allowance as may from time to time be sanctioned by the Commissioners will be paid. Free passage will be provided, with half-pay during the voyage out. The selected candidate must pass a medical examination.

Applications, stating whether married or single, age, and place of birth, and giving details of education, training, and experience, particularly in water works, and referring to all the above requirements in detail, accompanied by copies (only) of testimonials, and also personal references, must be lodged with Messrs. PRIERCE and WILLIAMS, MM. Inst. C.E., 180, Hope-street, Glasgow, Agents for the Commissioners (who will give further particulars if requested), not later than Tuesday, 10th March, 1925. 8471

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SITUATIONS OPEN

BOX P255, BOILER SHOP FOREMAN.—The ADVERTISER THANKS all APPLICANTS and notifies them that selected CANDIDATES have been COMMUNICATED with. P255 A

WANTED, SALESMAN for Handling Patent Furnace Bridge and Fire-bar for Marine Work, London.—Reply, stating age, salary, fullest details, to Z. H. 939, care Deacon's Advertising Offices, 7, Leadenhall-street, E.C. 3. 8493 A

WANTED, WORKS MANAGER for Boiler Works. Good organiser most essential, capable of securing large output. Mostly repetition work.—Address, stating experience and salary required, P315, The Engineer Office. P315 A

A CITY COMPANY REQUIRES for their Purchasing Department a well-trained CLERK, experienced in Enquiry and Purchasing Work; should have general knowledge of Mechanical and Electrical Engineering. Must be of good address and have unquestionable credentials.—Write, stating age, experience, and salary required, to Box "ELECTRICAL," care Advertisement Dept., 5, New Bridge-street, London, E.C. 4. 8461 A

ASSISTANT COMMERCIAL MANAGER REQUIRED for Industrial Light Railway Transport System near London. Young, energetic man.—Address, fully stating age, experience, and salary required, 8393, The Engineer Office. 8393 A

CAPABLE ENGINEER REQUIRED by Small London Firm to Assist Principal with a view to Partnership. Capital required £1000 to £2000. State fully qualifications.—Address, 8502, The Engineer Office. 8502 A

ENGINEER REQUIRED to Accompany Trading Expedition to the West Indies. Investment £500. Salary and expenses.—Apply, G. B. MEWBURN, Solicitor, Craven House, Kingsway, W.C. 2. P312 A

GENERAL ENGINEERING WORKS, Ceylon, REQUIRE ASSISTANT ENGINEER, single, 26-28, must be regularly indentured turner, fitter and erector with experience of responsible outside erection of Steel-framed Factories, Engines, Plant, and Millwrights' work; must possess technical qualifications and have D.O. or estimating office experience, capable of directing native labour, interviewing clients, securing orders, connected correspondence and reports. Commencing salary Rs. 500 per month. All applicants must state complete details, of technical training and practical experience, giving dates, with copies of references, since leaving school.—Address, 8439, The Engineer Office. 8439 A

YOUNG ELECTRICAL ENGINEER WANTED, for Works in Midlands (public school education preferred). Give full particulars, stating age and salary required.—Address, P333, The Engineer Office. P333 A

WANTED, ENGINEER'S JUNIOR DRAUGHTSMAN, capable of making Factory Plans for Re-organisation of Lay-out.—Apply, NICKELOID ELECTROTYPE CO., Ltd., 10, New Street-hill, London, E.C. 4. 8466 A

WANTED, First-class TRACER for General Arrangement Work.—Address, stating salary and experience, 8450, The Engineer Office. 8450 A

WANTED, SENIOR STRUCTURAL DRAUGHTSMAN, with good experience, preferably in London, of Steel-framed Building Designing and Shop Detailing; must be familiar with working of 1909 Act and used to making his own surveys.
Also First-class JUNIOR, with good experience, preferably in London, of Steel-framed Building Shop Detailing. State salary required in each case.
Apply, "DRAUGHTSMAN," c/o Ray Fielding and Co., 43, Old Queen-street, S.W. 1. P330 A

CHIEF DRAUGHTSMAN, Familiar with Design and Lay-outs of Boilers, Stokers, Pans, and with Combustion Engineering in general. Must be first-class organiser with initiative, and with capacity for getting work done.—Address, 8457, The Engineer Office. 8457 A

CHIEF DRAUGHTSMAN.—VACANCY Exists in Engineering Firm in Belfast manufacturing specialities. Capable of handling multiplicity of small contracts expeditiously. Must be good organiser and strict disciplinarian. Staff about 24. Only experienced first-class man will be considered. Replies strictly confidential.—Address in first instance, stating age, experience, and salary required, 8388, The Engineer Office 8389 A

DESIGNING MECHANICAL DRAUGHTSMAN REQUIRED AT ONCE in connection with Coal and Mechanical Handling Plants. Must have experience in Structural Work. Only men with first-class experience need apply. State age, experience, and salary required.—Address, P335, The Engineer Office. P335 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 7671 A

DRAUGHTSMAN, Experienced in Design of Chassis Components for Commercial Vehicles.—Write, giving age, experience, and salary required, to DENNIS BROS., Ltd., Guildford. 8472 A

DRAUGHTSMEN (Experienced) REQUIRED AT ONCE for Steel Railway Bridge Construction.—Address, 8491, The Engineer Office. 8491 A

DRAUGHTSMAN.—First-class SENIOR REQUIRED as Section Leader. Only men having considerable experience in All-metal Aircraft Design should apply.—THE H. G. HAWKER ENGINEERING CO., Ltd., Kingston-on-Thames. 8440 A

DRAUGHTSMAN, for Manchester District, with experience in design of Marine Refrigerating Machinery and Pipe Work. State age, experience, and salary required.—Address, 8451, The Engineer Office. 8451 A

DRAUGHTSMAN, Having Sound Experience in Steam Turbine Work.—Address, stating age, previous experience and salary required, with copies of references, 8388, The Engineer Office. 8388 A

DRAUGHTSMAN REQUIRED, with Knowledge of Commercial Vehicle design.—Address, giving age and particulars of experience, 8335, The Engineer Office. 8335 A

DRAUGHTSMEN (2) REQUIRED for Estimating Dept., Constructional Works, dealing in all classes of Steel-framed Buildings and Light Bridge Work for home and abroad. Only men of ability need apply. State age, experience, and salary expected.—Address, "STEEL," Wm. Porteous and Co., Advertising Agents, Glasgow. P281 A

DRAUGHTSMEN REQUIRED, with Knowledge of Colliery Plant, Screening and Washing Machinery. State experience and salary required.—Address, 8508, The Engineer Office. 8508 A

DRAUGHTSMAN WANTED, Capable, Thoroughly experienced in designing, estimating, and detailing of Structural Steel Work, Buildings, Bunkers, Conveyor Plants, Bridges, &c. Permanency to really good man. State age, experience, when at liberty, and salary required.—Address, 8507, The Engineer Office. 8507 A

INDIA.—DRAUGHTSMAN REQUIRED by a British Firm of Bridge and Structural Engineers, thoroughly experienced in preparing designs and working detail drawings for all classes of Steel-framed Buildings and Light Bridge Work. Must be a bachelor, age 24 to 28.—Write, stating age and giving full particulars of previous experience, to Z. E. 937, care Deacon's, Leadenhall-street, London, E.C. 3. 8496 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN WANTED, Experienced in Gas and Chemical Purification Plant, &c., and complete By-product Installations. State salary, experience, and when at liberty.—Address, 8402, The Engineer Office. 8402 A

DRAUGHTSMAN WANTED, Thoroughly accustomed to the design of Turbine Details; also ONE experienced in Plant Arrangements for Power Stations, &c. Apply, TRASER and CHALMERS ENGINEERING WORKS, Erith, Kent. 8438 A

MECHANICAL DRAUGHTSMAN WANTED. Must have been through shops. State age, experience, salary, when take up duties. Copies refs. (not returnable). Constancy for energetic man; one hour from London.—Address, 8473, The Engineer Office. 8473 A

RELIABLE DRAUGHTSMAN WANTED, Experienced in Light Railway Track, Truck and Carriage Design.—Address, stating age, experience, and salary required, 8443, The Engineer Office. 8443 A

REQUIRED, JIG and TOOL DRAUGHTSMEN, with experience in Aero-engine or High-class Motor Car Work.—Apply, P.O. Box No. 77, Bristol. 8464 A

TEMPORARY CIVIL ENGINEERING DRAUGHTSMAN REQUIRED; neat, quick and accurate; good leveller and surveyor. Student Inst. C.E. preferred. Salary £4 10s. per week.—Address, 8479, The Engineer Office. 8479 A

TRACER WANTED; Must be Neat, Quick, Accurate.—Apply, enclosing samples of work and stating age, experience, salary required, and when available, to FRASER and CHALMERS ENGINEERING WORKS, Erith, Kent. 8439 A

TOOL DESIGNER WANTED IMMEDIATELY, to Take Charge of Tool Drawing-office in N.W. London.—Address, stating age, experience, and salary required, 8330, The Engineer Office. 8330 A

ENGINEERS' PATTERNMAKER; Permanency for suitable man. District rate.—Apply, R. SMITH, 2 and 2a, Wynyatt-street, Goswell-road, E.C. 1. P239 A

IRON MOULDERS WANTED AT ONCE by Old-established Foundry and Engineering Works in Surrey doing high-class engine and similar castings. Every prospect of continuous work for right men. Only first-class men should apply, stating age, experience, and when at liberty.—Address, 8413, The Engineer Office. 8413 A

SITUATIONS WANTED

A GOOD OPENING REQD., Young Man, Practical, age 20, Polytechnic education, City and Guilds Exam. in D.O. or sales office; West London district preferred.—Address, P334, The Engineer Office. P334 B

ENGINEER, A.M.I.M.E., A.M.I.E.E., Long Experience China, SEEKS MANAGEMENT or REPRESENTATION. Excellent testimonials. Languages, French, German, Chinese.—Address, P316, The Engineer Office. P316 B

ENGINEER and WORKS MANAGER DESIRES CHANGE; held responsible positions, works and chief engineer; present works manager Radio Valve Co.; age 36.—Address, P277, The Engineer Office. P277 B

ENGINEER, Having Wide Experience in Commercial engineering and works control with large manufacturers and merchants, rolling mills, power plants, SEEKS POST, Assistant General Manager or Works Manager of Engineering Firm.—Address, 8484, The Engineer Office. 8484 B

ENGINEER, Mechanical (34), 1st Class B.O.T., held responsible charge workshops, technical and commercial training, late partner engineering firm, fluent Russian, some Hindustani, SEEKS POSITION, home or abroad.—WATERS, 16, Stanley-terrace, Swansea. P331 B

ENGINEER, Young Scotsman (23), Desirous of going abroad, complete knowledge of sugar milling machinery, WISHES SITUATION as ASSISTANT ENGINEER. Salary no object. Thoroughly qualified in the fitting and upkeep of mills. Excellent references.—Particulars from Box 75, OSBORNE-PEACOCK CO., Ltd., 42, Gordon-street, Glasgow. 8455 B

ENGINEER (29) SEEKS POST, Home or Abroad, inside or outside, erecting or maintenance. Experience with Diesel and steam, pumps, boilers, &c.—HARRIS, 15, Maxville-road, Balham, London. P309 B

ENGINEER (32), Production Experience on Up-to-date methods, charge of D.O., tool design, planning, shop routine, practical, SEEKS POST offering scope, preferably London district.—Address, P327, The Engineer Office. P327 B

MECHANICAL ENGINEER DESIRES ENGAGEMENT. Experienced in shop, foundry and boiler shop management and in the manufacture of sugar, chemical and colliery machinery. Have held successively positions as turner, fitter, draughtsman, travelling representative, assistant works manager, manager. University education.—Address, P296, The Engineer Office. P296 B

RESIDENT ENGINEER or CONTRACTOR'S AGENT, railways, bridges, tunnels, roads, deep foundations.—Address, P318, The Engineer Office. P318 B

SOCIETY OF TECHNICAL ENGINEERS, 102, BELGRAVE-ROAD, LONDON, S.W. 1.

TECHNICAL STAFF ENGINEERS, including MANAGERS, RESEARCH ENGINEERS, DESIGNERS, &c., AVAILABLE (owing to big staff reduction) from well-known Manufacturing Engineering Works specialising in volume output to precision limits and gauges.
For particulars please apply to the SOCIETY. 8453 B

STRUCTURAL ENGINEER, Just Returned from India, DESIRES to REPRESENT STRUCTURAL FIRM in England. Thorough technical knowledge. Speciality, bridge work.—Address, P310, The Engineer Office. P310 B

YOUNG Energetic ENGINEER (22), Having Completed apprenticeship, 5 years workshops and 12 months D.O., DESIRES POSITION with Civil Engineers.—R. A. TAPERELL, 49, Chestnut-grove, New Malden, Surrey. P323 B

AT LIBERTY, PRODUCTION ENGINEER, CHIEF DRAUGHTSMAN (37); mass production, planning, purchase, plant lay-out, general engineering and experimental work.—Address, P325, The Engineer Office. P325 B

DRAUGHTSMAN, Mech. and Jig and Tool (26), Tech. Coll. education, 9 years D.O. and works, excellent refs., SEEKS progressive POSITION.—W. J. H., 127, Church-street, Woking, Surrey. P310 B

DRAUGHTSMAN, 10 Years Shops and D.O., General engineering, first-class exp., plant lay-out, and mach. design, good mathematician, SEEKS POST, London dist.—37, Acacia-road, Stone, Greenhithe. P328 B

ENG. DRAUGHTSMAN (29), Used to Pipe Arrgts., oil fuel, oil pumping, steam, &c., DESIRES CHANGE (not necessarily as draughtsman) with prospects, home or abroad.—Address, P329, The Engineer Office. P329 B

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For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

A New Atlantic Cable.

THE President of the Western Telegraph Company, Mr. Newcomb Carlton, has arrived in this country in connection with a scheme to lay a new cable across the Atlantic. The first length of the cable will be laid between Penzance and Newfoundland, at a cost of about three million dollars, and next year another length will be laid between Newfoundland and New York, at a cost of two million dollars. The scheme will involve the enlargement of the Penzance station. Mr. Carlton is reported to have said that there are fifteen cables between North America and Great Britain, but most of them are obsolete, though not useless. The traffic between Great Britain and North America is increasing, and the reduced cost of working, which has resulted from the adoption of the new type of loaded cable, as used between America and the Azores, has led the company to decide to lay the new cable to Newfoundland, with a capacity of six million words a year.

The French Tariff Bill.

THE new Tariff Bill, which was to have been pushed rapidly through the French Chamber of Deputies during the present session, is still in abeyance, and it is probable that the measure is being purposely withheld in view of the changes that have taken place in the economic situation during the past few months. It is becoming more and more evident that French makers will have to depend upon foreign markets for the disposal of a large surplus production. It is also clear that if France raises still further the barriers against foreign goods, she will find great difficulty in obtaining the aid necessary to adjust her finances. The negotiations for a treaty of commerce with Germany have so far failed, because they were carried out on the supposition that the new Tariff Bill would come into operation at an early date. The new classification of goods under a higher minimum tariff would render the importation of certain products almost prohibitive, while the general tariff, which it is sought to impose upon Germany, renders the situation very much worse. In raising the barriers against foreign goods, France has merely encouraged other countries to follow her example, not as a means of protection, but mainly for the purpose of negotiation, and the final result will be that commercial treaties will have no effect in facilitating trade exchanges unless they aim at a reciprocal reduction of duties all round. This result could not be achieved if the Bill, with its minimum tariff, passed through Parliament. There is some reason for hoping that in view of the economic problems which are now presenting so many difficulties, an attempt will be made to render the Tariff Bill less rigid in application and more adaptable to the requirements of foreign trade.

Another Birmingham Reservoir.

THE Birmingham Water Committee has just decided to accept the tender of E. Nuttall, Sons and Co. for the construction of a new reservoir at Bartley, which will greatly increase the storage capacity of the local system. It is now some time since it was decided that the present Frankley reservoir, at the Birmingham end of the Elan Aqueduct, was inadequate, but it only remains for the necessary legal formalities to be completed for the work to be put in hand. The Frankley reservoir has a capacity of 200 million gallons, and is used to augment the supply when the demand is beyond the capacity of the aqueduct, the deficiency being made up again in times of lesser demand. The new reservoir will have a capacity of 500 million gallons, and will be formed by constructing a dam about 60ft. high across a valley down which runs a small stream. The lake thus formed will be about two-thirds of a mile long by one-third of a mile wide at the widest part.

Electricity in the Home.

IN a report presented at a recent meeting of the London County Council, the General Purposes Committee discussed the possibility of the general replacement of gas by electricity for lighting, heating and cooking, the conclusion expressed being that, mainly on the grounds of cost, the change at present is impracticable. Success in the extended use of electricity for heating and cooking is considered to be dependent in a large measure upon the attitude of the local electricity authorities, and unless they are anxious to develop their domestic loads, a general change-over from gas to electricity is not likely to be brought about. Another factor, the report stated, is the necessity for educating the public in the use of electric appliances. In the past, the gas companies have educated the public in the use of gas appliances, and it is argued that the electricity authorities must render similar service in the use of electrical apparatus. The Housing Committee is also of opinion that until further developments take place in the conditions governing electricity supply in Greater London, the supply companies will be loath to incur capital expenditure because they could not secure an adequate return before the date when their undertakings may be purchased from them. Without the wholehearted co-operation of the supply authorities, the possibilities of a general introduction of electricity into the Council's dwellings are small, and the proposals that have been put forward would, it is considered, meet with a very varying degree of success.

A State Shipping Failure.

ACCORDING to news from Melbourne, the Australian Commonwealth Line is to be offered for sale. The management and control of the affairs of the undertaking were last year vested in an independent Shipping Board. The Board now states that while the ships remain on the Australian register and are subject to Australian industrial awards, the line cannot continue to be run without serious loss. The losses since 1921, together with the sum written off the capital, amount, it is stated, to no less than £11,091,631. During the year 1921–22 the loss was £1,171,569, while the following year it was £1,626,150, and in June, 1923, the value of the fleet owned by the line was written down from £12,766,588 to £4,718,500, a reduction of £8,048,088. It is understood that the Australian Government will immediately invite tenders for the purchase of the line. Conditions to be observed by the purchaser include the maintenance of a regular service between Australia, Great Britain and Europe, no increase of fares or freights charged, and no arrangement to be made with any shipping combine. The fleet consists of over thirty ships, which vary in size from 3300 to over 13,800 gross tons. Among the larger ships are five of the "Esperance Bay" and "Moreton Bay" type, which were built comparatively recently by William Beardmore and Co., Limited, and by Vickers Limited. Should a satisfactory offer be received, it is probable that the Australian Government would recommend Parliament to accept it.

The Late Sir Robert Turnbull.

THOUGH he was not professionally an engineer, Sir Robert Turnbull, M.V.O., who died on Sunday last, deserves mention in these pages because few men have done more to make railway travel safe, expeditious and comfortable. For nearly twenty years he was the superintendent of the line of the London and North-Western Railway and responsible, therefore, for the operation of that vast system. It was his business to initiate all schemes for widenings, enlargements and alterations; to approve all the plans for such works and for the signalling, block working, &c., which they involved. The working of all passenger trains, of all goods trains outside the goods yards and of all engines was in his charge, and all the passenger staff was under his supervision. The responsibilities of such a position were very great and particularly on so big a system as the London and North-Western. Sir Robert was one of the three members of the Railway Employment Safety Appliances Committee, having been appointed thereto as the companies' representative when that body was constituted in April, 1906. He was knighted when the King and Queen visited Crewe in 1913, and was the first railway superintendent to be so honoured. Sir Frank Ree, the then general manager, died in April, 1914, and Mr.—afterwards Sir—Guy Calthorp was appointed his successor. Until he could arrive in this country from the Argentine Sir Robert acted as general manager, and was holding that office when war broke out. Thus he became a member of the Railway Executive Committee, and so valuable were his services on that body that he was co-opted a member on his retirement from the position of general manager in September, 1914. In the following December he was made a director of the London and North-Western, and when Mr. J. F. S. Gooday died in February, 1915, and a vacancy occurred on the board of the London, Brighton and South Coast Railway, it was felt that Sir Robert's election as a director would be of immense advantage, and it was therefore effected.

Seventy Capital Ships Scrapped.

WITH the sinking of the Japanese battleship Tosa, which took place recently, the last of the vessels condemned under the Washington Treaty has disappeared, Great Britain and the United States having previously disposed of all their redundant craft. Seventy capital ships in all were listed for scrapping, or 78 if eight Japanese vessels projected but not laid down are included in the total. Of these ships, 30 were American, 24 British, and the remainder Japanese. This country discharged its obligation when the Monarch was sunk by gunfire off the Scillies a few weeks ago. The last American ship, Washington, was also expended as a target during December, while the Tosa completes the Japanese list of victims. This latter vessel, it may be mentioned, was the largest and most powerful of the ships already afloat which the Treaty required to be sacrificed. Launched late in 1921, the Tosa was designed as a battleship of 40,000 tons, with a speed of 23 knots, and would have mounted the formidable armament of ten 16in. guns. A sister ship, the Kaga, has been retained for conversion into an aircraft carrier, as a substitute for the former battle-cruiser Amagi, which was irreparably damaged in the great earthquake as she lay on the stocks. It is understood, however, that the four British ships of the "Improved Hood" class were the largest actually under construction which were scrapped in accordance with the Treaty. Their keels had been laid, though building operations were in a early stage of progress. In one of the statements made to the Conference the displacement of these British ships was referred to as being about 47,000 tons, which would have made them heavier by 5800 tons than the Hood.

Empire Exhibition Finances.

IN an official statement regarding the financial position of the British Empire Exhibition on the closing date, November 1st, the Exhibition authorities have revealed the fact that on last year's working there was a deficit of £1,800,000. The capital outlay on the site, the construction of the buildings and so forth, involved an expenditure of £2,950,000, while upkeep, salaries, publicity and other items falling under the maintenance account, totalled £950,000. On the revenue side the receipts from admissions, rent of space and the letting of concessions, brought in £2,100,000. To the deficit thus revealed must be added a liability of £150,000 for entertainment tax duty on admissions to the Exhibition. The guarantee fund is not sufficient to meet the deficit, for it amounts only to £1,207,991. In it there is included a sum of £100,000, which was guaranteed by the British Government. A resolution that subject to sufficient support being secured for the Exhibition this year and to the other guarantors continuing their guarantees, the Government should increase its guarantee to a total figure of £1,100,000 was agreed to by the House on Wednesday last. It is intended to open the Exhibition in the first week of May and to keep it open until the end of October.

The Maiden Voyage of the Aorangi.

IT is reported by members of the party which accompanied the Fairfield-built quadruple-screw motor liner Aorangi on her maiden voyage as far as San Francisco, who have now returned, that the vessel made a remarkably successful voyage. On her outward trip the Aorangi only used 55 tons of oil per day for all purposes, including the main propelling machinery, auxiliary machinery, kitchen galleys and heating boilers. Throughout the run, the Fairfield-Sulzer engines worked without the slightest interruption, and with a smoothness and freedom from vibration, which, it is stated, was without parallel in the experience of those on board. At all the ports of call the Aorangi was received with the greatest enthusiasm, the reception at Los Angeles and San Francisco being particularly notable. The vessel arrived at San Francisco well ahead of her scheduled time, and she will be shortly due at Auckland, her terminus for the voyage. The Aorangi, it will be remembered, was fully described and illustrated in the first four issues of THE ENGINEER for this year. The Union Steamship Company of New Zealand has at present six other ships in course of construction on the North-East Coast. They include a twin-screw tanker, which will also be propelled by Sulzer type engines, and five steamships for the cargo and passenger services of the company.

The Late Sir Edward Thorpe.

THE death of Sir Edward Thorpe, F.R.S., on Monday removes one who was not only an eminent chemist, but a scientist of wide attainments. In the earlier stages of his scientific career, he took a considerable interest in astronomy, and was engaged in four solar eclipse expeditions, of one of which, in 1893, he was the leader. He also paid great attention for a time to magnetic survey work. In conjunction with Sir A. Rucker, he made two magnetic surveys of the British Isles, the results of the second of which, when published in the "Philosophical Transactions" of the Royal Society, occupied nine complete volumes. He engaged, in addition, in magnetic survey work in various other parts of the world. These activities were supplementary to his work as a chemist. His scientific career was begun at Owens College, Manchester, near which city he was born. Subsequently, he studied chemistry in Germany, and on his return acted as a demonstrator under Sir Henry Roscoe at Owens College. In 1870 he was appointed Professor of Chemistry at the Andersonian Institution, Glasgow, and in 1874 he moved to the Chair of Chemistry at the newly established Yorkshire College at Leeds. In 1885 the Royal College of Science drew him to London in a similar capacity, and in 1894 he was made Principal of the Government Laboratories. For sixteen years he continued in that post, and then returned to South Kensington as Professor of General Chemistry at the Imperial College of Science and Technology. He was President of the Society of Chemical Industry in 1895, of the Chemical Society in 1899–1901, and of the British Association in 1921. His investigations covered a very wide field, ranging from the chemical nature of liquids to the determination of the atomic weight of radium. Of the many books for which he was responsible, he will always be chiefly remembered for his "Dictionary of Applied Chemistry," a monumental and invaluable work which was first published in 1890.

The British Steam Railway Locomotive from 1825 to 1924.

By E. L. AHRONS, M.I. Mech. E.

No. IX.*

LOCOMOTIVE PERFORMANCE TO END OF 1845.

IT is convenient here to give a few particulars of the work done by early locomotives down to the end of 1845, when the Gauge Commission was sitting. Locomotive performances formed a large portion of the evidence laid before the Commissioners, and ultimately led to the celebrated trials between the broad and the narrow-gauge engines.

The Stockton and Darlington was a slow-speed coal-carrying railway. Pambour stated that the fuel consumed by the mineral engines was about 54 lb. per mile, or .86 lb. per ton gross per mile. He also gave a table showing that during five months, at the end of 1833, 23 mineral engines of all types performed work equivalent to 5,802,562 gross ton-miles on a level at a cost of .058 penny per ton-mile for repairs.

Of the passenger engines Whishaw, in 1839, timed two, the "Sunbeam." 2–2–0 type, by Hawthorn, and Hackworth's short stroke 2–2–2 engine "Arrow," the latter having the lever between piston and connecting-rods—see page 96). A maximum speed of 42.8 miles per hour was attained by the "Arrow" on the down journey from Shildon to Stockton, the average speed being 25.3 miles per hour. The weight of train was only about 8½ tons. The "Sunbeam," with 20½ tons from Stockton to Darlington, attained a maximum of 30 miles per hour, and an average of 16½ miles per hour with a strong side wind blowing.

The early 2–2–2 passenger engines of the Hull and Selby Railway consumed 33.6 lb. of coke per mile, or .84 lb. per ton-mile, but Gray's engines Star and Vesta, with the "horseleg" expansion gear, were said to have burnt 14.9 lb. per mile, or .37 lb. per ton-mile.

The most detailed information comes from the records of the Liverpool and Manchester Railway. Pambour's data of 1834 are analysed at some length in Colburn's "Locomotive Engineering," pages 34–37, but only four examples need be given here as a basis for comparison with later engines :—

TABLE I.

Engine.	Type.	Diameter of driving wheels.	Cylinders.	Weight of engine.	Weight of tender and train.	Average pressure.	Average speed throughout journey.	Coke per mile.	Water evaporated per 1 lb. coke.	
				Tons.	Tons.	lb. sq. in.	m.p.h.	lb.	lb.	
Vesta	2–2–2	5ft.	11½in. × 16in.	8.71	33.15	51	27.23	26.0	5.34	Pass
Leeds	,,	,,	11in. × 16in.	7.07	88.34	54	18.63	30.4	6.68	,,
Fury	,,	,,	,,	8.2	48.8	57	18.63	27.3	7.3	,,
Atlas	0–4–2	,,	12in. × 16in.	11.4	195.5	53.7	9.72	54.1	5.18	Goods

The coke consumptions are net, when running only. It was estimated that much steam was lost at the safety valves. Colburn calculated that the best L. and M. engines in 1834 consumed at least 10 lb. of best coke per indicated horse-power hour, and that probably 11 lb. to 12 lb. was nearer the actual consumption. But it must not be forgotten that there was then no lap on the valves, and the steam was admitted throughout the stroke. Cost of repairs per train mile rose steadily from 9.3d. in 1832 to 13.1d. in 1834.

Ed. Woods[1] stated that during 1838–9 the average coke consumption attained its maximum of about 49 lb. per mile—including lighting up and standing—for passenger trains averaging seven coaches, and 54 lb. with goods trains averaging 16 wagons. During 1839 John Gray's expansion gear was fitted to the "Cyclops," a passenger engine, with the result that its gross consumption dropped from 40.1 lb. to 32.4 lb. per mile, though in another part of the same paper 28.5 lb. is given. By altering the valves and giving them 1in. lap, and also by seeing that the firing was much more carefully done, the consumptions in 1840–1 for passenger engines averaged 22 lb. to 26 lb. per mile with seven coaches.

Between 1840 and 1845 practically the whole of the Liverpool and Manchester locomotives were completely renewed, and the standard passenger engines, with 5ft. wheels and 12in. by 18in. cylinders burnt 14½ lb. to 18 lb. of coke per mile with seven coaches—say, 50-ton—loads. The new 0–4–2 goods engines with 5ft. wheels and 13in. by 20in. cylinders, consumed 21 lb. to 24¾ lb. per mile with average loads of 110 tons behind the tender.

The ton-mile consumptions of coke—Table II.—are taken from the Gauge Report and refer to the 18 months' period ending December, 1844. The entries in the last column are the writer's.

On the Grand Junction Railway there were only two engines with four wheels coupled, and the goods trains, when heavy, were worked by two passenger engines. It was also the usual practice on the London and Birmingham Railway to employ two or more of Bury's four-wheeled 0–4–0 engines on the goods trains.

The comparative costs of operation of three of the best known standard gauge passenger locomotives of the 1844–5 period—see Table III.—are taken from Mr. B. Cubitt's evidence, and relate to engines running on the Brighton and Dover Railways. The engines were new at the first dates given.

One of the Stephenson type long boiler 0–6–0 engines with inside cylinders 15in. by 24in. and 4ft. 9in. wheels, built by Kitson and Co., was specially tested during four double trips on the Midland Railway between Derby and Rugby in 1845. With a load of 315½ tons behind the tender the coke consumption was 46.8 lb. per mile, or .16 lb. per ton-mile. On another occasion with 348¾ tons from Rugby to Leicester—20 miles—on which there is one rising gradient of 1 in 330, the average speed was 22 miles per hour. From Leicester to Derby—29 miles—with 290 tons the average speed was 25¾ miles per hour, the gradients being easy. The coke consumption over the whole journey was 48 lb. per mile, or .153 lb. per ton-mile.

Much evidence was given before the Gauge Commission in regard to evaporative power of boilers, principally the long boilers of Stephenson's engines and the ordinary type of Gooch's Great Western engines. The figures, which differed considerably, were of little or no value, being mostly obtained by the crude method of measuring the depth of the water in the tender with a stick. The initial temperatures appear to have been carefully avoided, and Gooch complained with reason that the narrow gauge party, represented by Mr. G. P. Bidder, heated the water from outside sources before starting. "Priming," to which many standard gauge engines of that day were somewhat prone, must have bulked largely in some of the results, and may account for Bidder's figures of 7.8 lb. of water on the broad gauge, as compared with 9.6 lb. on the narrow gauge per pound of coke burnt. The "standard" appears to have been "from and at any temperature obtainable at the start."

TABLE II.

Railway.	Passenger. Average weight of trains.	Passenger. Coke per ton-mile, pounds.	Goods. Average weight of trains.	Goods. Coke per ton-mile, pounds.	Type of engine.
Great Western (broad gauge)	67	.55	265	.27	Passenger, 2–2–2, 7ft. Goods, 2–4–0 and 0–6–0
Manchester and Liverpool	30	.56	100	.24	Passenger, 2–2–2, 5ft. Goods, 0–4–2, 5ft.
Grand Junction	43.5	.53	152	.33	Passenger and goods, worked by 2–2–2, 5ft. 6in. and 5ft.
London and Birmingham	42.4	.87	162	.43	Passenger, 2–2–0 Bury Goods, 0–4–0 Bury

Speeds.—Omitting Pambour's Liverpool and Manchester experiments, the earliest speed records were those made by Whishaw in 1839, the analysis of which contains some items of interest. The highest speeds mentioned are 68.2 miles per hour down the Madeley Bank of 1 in 177 into Crewe on the Grand Junction Railway. Analysis of these particular speeds shows that they cannot be accepted. There were four different trains with which 68.18 miles per hour were recorded, but no train on the same section showed a maximum speed between this and 56¾ miles per hour. The explanation can be supplied from Whishaw's own notes. On the Madeley Bank there were distance posts every 100 yards, and he attempted to record the times passing each post. Experience of reliable train timing shows how difficult it is even to obtain accurate ¼-mile-post readings, and an error of half a second in Whishaw's 100-yard timings would reduce his 68.2 to 58¼ miles per hour. Moreover, the 68.18 miles per hour of the four trains is equivalent to the 100-yard interval in three seconds exactly, a suspiciously round number. On no other railway does Whishaw record any speed exceeding 50 miles per hour, and even this was exceptional. The probability is that 55 to 58 miles per hour was the maximum, very rarely attained even down the Madeley Bank. The writer has dealt with this point in the interests of accuracy, since even Colburn[2] accepted Whishaw's 68.2 miles per hour without due consideration.

Whishaw's other records, taken at half-mile and mile posts, are more reliable. He records a maximum of 50 miles per hour on the Liverpool and Manchester Railway with a 2–2–2 engine, on a run of 14¼ miles with one stop. The running average, excluding the stop, was 30½ miles per hour, with a load of 22½ tons. There is also one record of 50 miles per hour on the London and South-Western with 46 tons down 1 in 388 near Woking.

The most interesting records are those of the London and Birmingham Railway, since they show performances of Bury's four-wheeled locomotives. The four-coupled goods engines gave higher speeds on the passenger trains than the "single" engines, though this is not apparent from Whishaw's figures, since he gave no particulars of the engines beyond recording their numbers. From a large number of timings the following have been selected :—

Engine.	Distance travelled miles.	Load tons.	Max. speed.	Average speed.	
Passenger.					
5ft. 6in., 12in. × 18in.	15¾	57½	37.5	23.8	
Ditto	112½	27½	42.8	23.7	
Ditto	60	62	46.1	26.4	Two engines
Goods.					
5ft., 13in. × 18in.	35	27	40.5	27.8	
Ditto	42	37¼	50.0	26.8	

The average speed is that of the train when in motion, and owing to stops is lower than would have been the case with through runs.

On the G.W.R. broad gauge the timings were made between Paddington and Maidenhead only. The best result was given by Stephenson's "North Star," which, with 30 tons, averaged 31.8 miles per hour, the maximum speed being 46.8 miles per hour. Maximum speeds of 50 miles per hour were attained by the 8ft. engines "Vulcan" and "Bacchus," but with loads of 14 to 17½ tons only.

From 1839 until the end of 1845 very little is known on this subject. The run from York to Darlington in 1845 at an average speed of 51 miles per hour by Hawthorn's 6ft. 6in. single engine has already been mentioned. The fastest speeds on the standard gauge are stated to have been attained on the North Midland and the Eastern Counties railways (Bishop's Stortford line), but no exact particulars are obtainable. Both railways employed express engines with 6ft. driving wheels.

But there is no doubt that the Great Western carried off the speed honours. During the trials the "Ixion," with 7ft. wheels and 15½in. by 18in. cylinders, ran from London to Didcot at an average speed of

TABLE III.

Maker.	Type of engine.	Driving wheels.	Cylinders.	Heating surface: Tubes sq. ft.	Heating surface: Fire-box sq. ft.	Continued working.	Miles run.	Coke per mile.	Cost of repairs. £ s. d.	Repairs, pence per 100 miles.
Sharp Brothers	2–2–2 inside cylinders outside frames	5ft. 6in.	15in. × 18in.	476	60	Feb., 1844 to Apl., 1845	40,135	31.54	137 8 8	82.18
Bury	2–2–0 inside cylinders inside bar frames	5ft. 6in.	14in. × 18in.	595	59	Aug., 1844 to Apl., 1845	14,626	35.07	109 7 10	179.5
Stephenson	2–2–2 long boiler outside cylinders	5ft. 6in.	15in. × 22in.	893	55	Oct., 1844, to Apl., 1845	18,447	29.55	67 14 1	88.08

* No. VIII appeared February 27th.

[1] "Observations on the Consumption of Fuel and the Evaporation of Water in Locomotive and other Steam Engines," published in Tredgold's "Steam Engine."

[2] "Locomotive Engineering," page 55.

47.5 miles per hour, with 81½ tons, and at 52.4 miles per hour with 61 tons. On the return journeys, the gradients being slightly downhill, the running averages were 50 miles per hour with 81½ tons, and 54.6 miles per hour with 71 tons. Maximum speeds of 60 to 62 miles per hour were attained.

The standard gauge trials between York and Darlington were carried out with one of Stephenson's long boiler engines with rear driving wheels 6ft. 6in. diameter and outside cylinders 15in. by 24in. The average speeds were about 47 miles per hour with 50 tons and 43¾ miles per hour with 80 tons. The highest speeds were 58 and 50¾ miles per hour respectively. The same engine, about three weeks later, attained 60 miles per hour with a 40-ton train on the same line.

The highest booked time-table speeds in 1845 were :

G.W.R., Swindon to Bath	29¾ miles at	48.2 m.p.h.	
,, Paddington to Didcot ..	53 ,,	47.5 ,,	
,, Taunton to Bristol.. ..	44¾ ,,	47.1 ,,	
E.C.R., London to Broxbourne ..	19 ,,	43.6 ,,	
L. and B.R., Wolverton to Coventry (including one stop).. ..	41¼ ,,	43.7 ,,	

New Dock Equipment on the Clyde.

No. I.

DEWATERING PLANTS FOR GRAVING DOCKS NOS. 1 AND 3.

THE Trustees of the Clyde Navigation have recently completed the remodelling of the hydraulic and electrical equipment at Prince's Dock, and at the Graving Docks adjoining it, and we were recently invited to make a detailed examination of the whole installation, which includes two sets of dewatering pumps of different types, an hydraulic pumping station, a pneumatic supply station, all electrically operated, and several rotary converters.

For a considerable period before the termination of the war, the Trustees had recognised that the time was approaching when the plant which has now been replaced would have to be brought up to date, so as to satisfy modern requirements and conditions. For one thing, the machinery had been installed for many years, and in any case would very soon have had to be replaced in the natural course of things, and, on the other hand, it was felt that in order to keep abreast of the times a general remodelling of the whole equipment using electricity as the motive power was advisable, if not, indeed, imperative. Naturally, but little could be done during the continuance of hostilities, though, as we shall show, some progress in the desired direction was made even before the signing of the Armistice, but since that time the work has steadily progressed, with the result that the Trust is now possessed of pumping, hydraulic, pneumatic and electric installations of the most modern type which can most efficiently satisfy any demands that can possibly be made upon them. Furthermore, in those directions in which the demand is likely to increase, in future, beyond what it is now, provision has been made for ready extension.

The new equipment embodies some features which are distinctly novel, and as it is operating most successfully in every direction, we feel sure that a description of it will prove of interest to our readers. We therefore propose to discuss in the four following articles—(1) the dewatering plants for Graving Docks Nos. 1 and 3; (2) the hydraulic services for Prince's Dock and for Graving Docks Nos. 1, 2 and 3; and (3) the pneumatic and electric services for Prince's Dock and the three Graving Docks. For permission to publish these articles we are indebted to the courtesy of the Trustees of the Clyde Navigation, who afforded us every facility for making our inspections and for obtaining the necessary particulars, drawings, &c.

At the outset, we may explain that the whole of the machinery which we are about to describe was supplied to specifications and plans prepared by, and was installed under the supervision of, Messrs. Walter Bridges and Co., of 37, Parliament-street, Westminster, who worked in collaboration with Sir William Rowan-Thomson, K.B.E., the convener of the Workshops Committee of the Navigation Trust, and, in the early stages, with the late mechanical engineer, Mr. George H. Baxter, and subsequently with his successor, Mr. Daniel Fife. The previously existing buildings were cleverly utilised and adapted to the fullest possible extent, and the necessary new building and structural operations, as well as the work in connection with the new foundations, &c., were carried out to Messrs. Bridges' plans by the constructional department of the Trust. The supplementary mechanical work, of which naturally there was a considerable amount, as might be expected in a reorganisation of plant of such magnitude, was effected by Mr. Fife.

Before going on to describe the equipment in detail, it will perhaps be useful if we say a few words about the docks in which it has been installed. Prince's Dock is on the south bank of the Clyde, and lies about a couple of miles downstream from the centre of the city. It is a tidal dock, which is capable of accommodating steamships of very large dimensions. The three Graving Docks—Nos. 1, 2 and 3—lie parallel to one another to the westward (*i.e.*, downstream) of the main dock, and are entered from the latter.

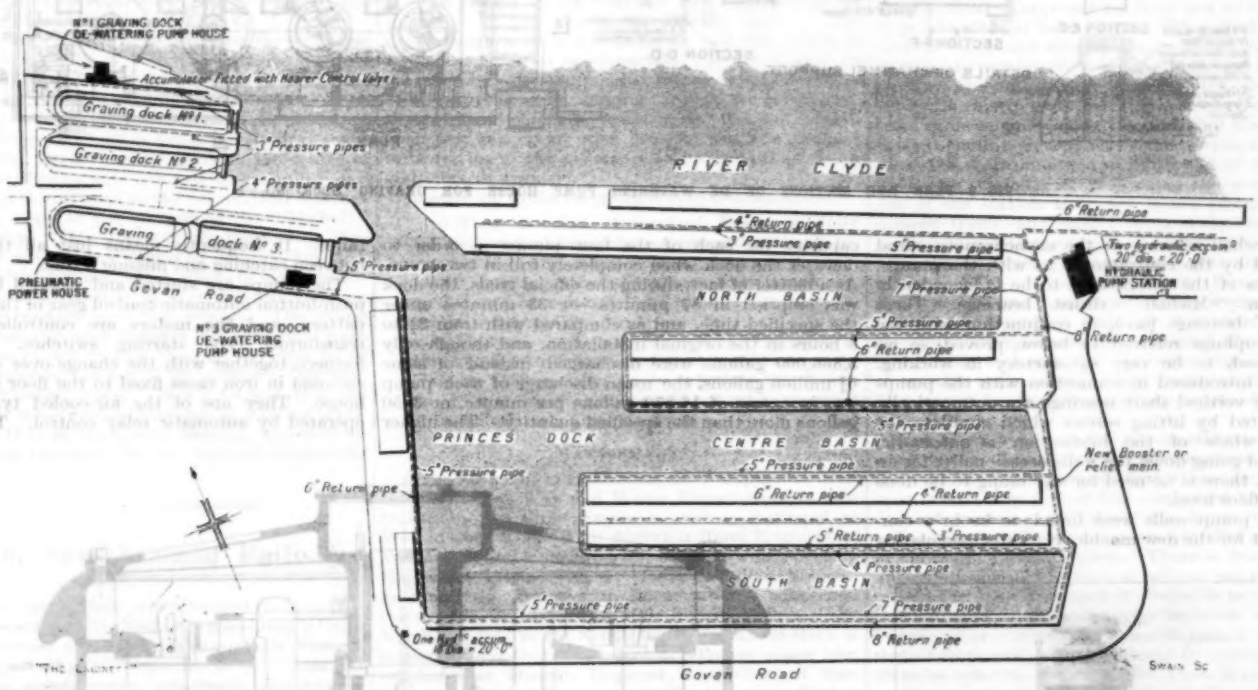


FIG. 1—PLAN SHOWING PRINCE'S DOCK AND GRAVING DOCKS NOS. 1, 2 AND 3 AND POSITIONS OF POWER HOUSES

The accompanying drawing—Fig. 1—shows the relative positions of the various docks and of the different power houses. As will be observed, the first two Graving Docks are single, while Dock No. 3 can be converted into two docks, 420ft. and 460ft. long respectively, by means of an additional pair of gates. Dock No. 3 has a total length of 880ft., a width at the entrace of 83ft. at bottom, and a depth of water on the sill at average high water of spring tides of 26ft. 6in. The width of the body of the dock at cope level is 115ft. At the time it was built it was one of the largest structures of its kind in the world. When there is no vessel in it, and with a tide of 26ft. 6in. over the sill, its capacity, or the quantity of water to be removed in order to empty it, is about 13¾ million gallons. The original dewatering plant had been in service for over twenty-five years. It consisted of two twin-cylinder high-pressure vertical steam engines, with cylinders, 28in. in diameter and 24in. stroke, and designed for a working pressure of 110 lb. per square inch, each coupled direct to a centrifugal pump with a disc 8ft. in diameter. The engines had a maximum speed of 118 revolutions per minute, and they exhausted to atmosphere. The pumps, which were of the horizontal type, had two suction pipes, each 44in. in diameter, and one discharge pipe, 60in. in diameter.

Graving Docks Nos. 1 and 2 are both about the same size, and are considerably smaller than Dock No. 3. Dock No. 1 has a capacity of about 1 million cubic feet, and when full with no vessel in it holds some 6½ million gallons of water. The original dewatering plant consisted of four vertical-spindle centrifugal pumps driven direct by two-cylinder high-pressure engines exhausting to atmosphere. There was no separate plant for dewatering Dock No. 2, which was partly done by the No. 1 dock pumps and partly by those of No. 3 Dock. The pumps used to take from 2½ to 3 hours to empty Dock No. 1. In the pump house for Dock No. 1 there was also a steam-driven three-throw draining pump to keep the dock free of water when it was empty. The draining of Dock No. 3 was effected by a small steam-driven centrifugal pump.

When the decision was arrived at that the time had come when a more efficient and up-to-date plant should replace these pumping plants, the consulting engineers, after going carefully into the question, recommended that the most economical scheme, having due regard to the ratio of capital cost to the economy which would be effected over the plant as it then existed, was, as concerned pumping plant No. 1, to discard the four original pumps with their boilers and accessories and to replace them with modern vertical-spindle high-efficiency pumps, each driven direct through flexible coupling by a 130 to 140 brake horse-power three-phase alternating-current electric motor, deriving its energy from the power mains of the Glasgow Corporation. It was also recommended that the existing three-throw drainage pump, which had originally been designed for this special duty, should be adapted to be driven by a 440-volt electric motor.

With regard to the No. 3 Dock dewatering plant, it was proposed to do away with the vertical steam engines and pumps with their boilers and accessories, and to replace them by two electrically driven, single-stage, self-balanced, double-inlet centrifugal pumps, with two suction branches and one delivery branch connected to the previously existing suction and delivery pipes. The recommendation was made that the motors, which were each to be capable of developing from 600 to 650 brake horse-power at an asynchronous speed of 205 revolutions per minute, should be operated at 6600 volts with alternating current taken from the Corporation's extra high-tension mains. The old drainage pump, it was suggested, should be taken out and replaced by a high-efficiency vertical spindle centrifugal pump driven direct by a 440-volt alternating-current motor.

These recommendations were accepted in their entirety by the Trustees, and tenders for the work were invited in November, 1919, with the result that the contract for the six pumps was entrusted to Worthington-Simpson, Limited, the sub-contractor for the electric motors for No. 1 Dock being the General Electric Company, Limited, and those for No. 3 Dock being Crompton and Co., Limited.

No. 1 GRAVING DOCK PUMPS.

For Dock No. 1 the specification provided for four vertical-spindle motor-driven centrifugal pumps, each to be capable of discharging a mean quantity of not less than 13,000 gallons of water per minute during the period of "dock full" to "dock empty," and against high-water level at a speed not exceeding 360 revolutions per minute. Among the special stipulations made were :—(*a*) That the impellers were to be of cast steel with renewable steel rings on the hubs, and renewable cast tongue or bridge pieces; (*b*) that the impeller thrust was to be

carried independently by "Michell" thrust bearings fitted to the top covers of the pumps, and that the pumps were to have a characteristic which would insure no overload with zero head features, and a maximum efficiency under the varying heads experienced. The vertical spindle motors were specified to be of the squirrel cage type and suitable for a three-phase alternating-current 440 volts 25-cycle service. They were to be eight-pole machines each capable of developing 140 brake horse-power continuously when running at the asynchronous speed guaranteed by the contractor. As with the pumps, the weights of the rotors were to be independently carried on "Michell" thrust bearings. These "Michell" bearings have, in conjunction with the flexible couplings referred to below, proved, so we are informed, to be very satisfactory in working. A novelty introduced in connection with the pumps is that the vertical shaft bearings are automatically oil lubricated by lifting screws which circulate the oil. The whole of the lubrication is automatic, and beyond going down the wells occasionally, for an inspection, there is no need for any oiling to be done below the floor level.

The oil pump wells were found to be in a condition unfit for the new machinery, water percolating into them from the river and docks. After they had been rendered inside, however, by means of a special method, they were made absolutely waterproof, and are, at the present time, as dry as a house above ground.

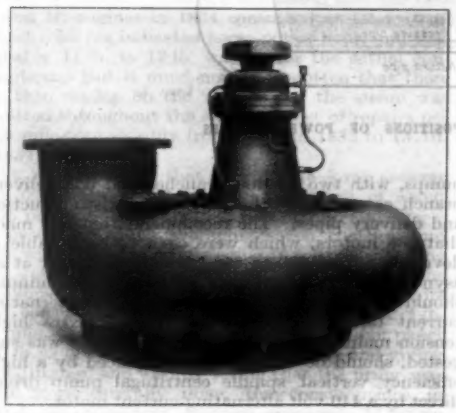


FIG. 3—VERTICAL SPINDLE PUMP

The top ends of the pump shafts, where they are coupled to the motors, are furnished with flexible couplings of the Zodel-Voith belt-laced type. These couplings are capable of dealing with longitudinal play up to ½in. to allow for expansion and independent adjustment of the armatures of the motors relatively to the pump impeller shafts as well as to provide a safety release in the event of the pumps jamming. The shafts are, therefore, free to expand without exercising thrust on or adding weight to the motor or pump bearings. The arrangement of the plant is shown in the drawing Fig. 2, while interior views of the pump house are given in Figs 5 and 6, page 242, and a view of one of the pumps in Fig. 3. The drawing from which Fig. 2 has been prepared, as well as those from which the remainder of the engravings used to illustrate these articles were reproduced, were taken from the general arrangement drawings and details prepared by Walter Bridges and Co., in connection with the carrying out of the work.

The delivery volume specified for each pump—13,000 gallons of water per minute—is the necessary capacity for each of the four pumps in order to dewater the dock when completely full in two hours. As a matter of fact, during the official trials, the dock was emptied in 87 minutes—or 33 minutes under the specified time, and as compared with from 2½ to 3 hours in the original installation, and though only 5,866,000 gallons were discharged instead of some 6¼ million gallons, the mean discharge of each pump was in excess of 16,850 gallons per minute, or 3850 gallons more than the specified quantity. The higher rate of pumping involved a slight overload on the motors above the normal specified, but it was well within the normal overload capacity provided for. It is interesting to note that, in spite of this overload, the temperature rises of the motors was within the figure specified for normal rating horse-power. The makers had guaranteed a maximum overall efficiency of 65 per cent., with the characteristic as specified by the consulting engineers. Actually, the maximum overall efficiency attained was 69 per cent., the average overall efficiency over the period of pumping out the dock being 47¼ per cent. The static head pumped against varied from 0.75ft. to 19.5ft. The total of Board of Trade units consumed during the official test when 5,866,000 gallons were pumped was 870. In other words, 6743 gallons were pumped out for each unit of energy consumed. It can well be understood that the ability to empty the dock in half the time required by the old plant, which the Trustees now possess, is of great commercial importance. It frequently means just all the difference between catching and missing a tide.

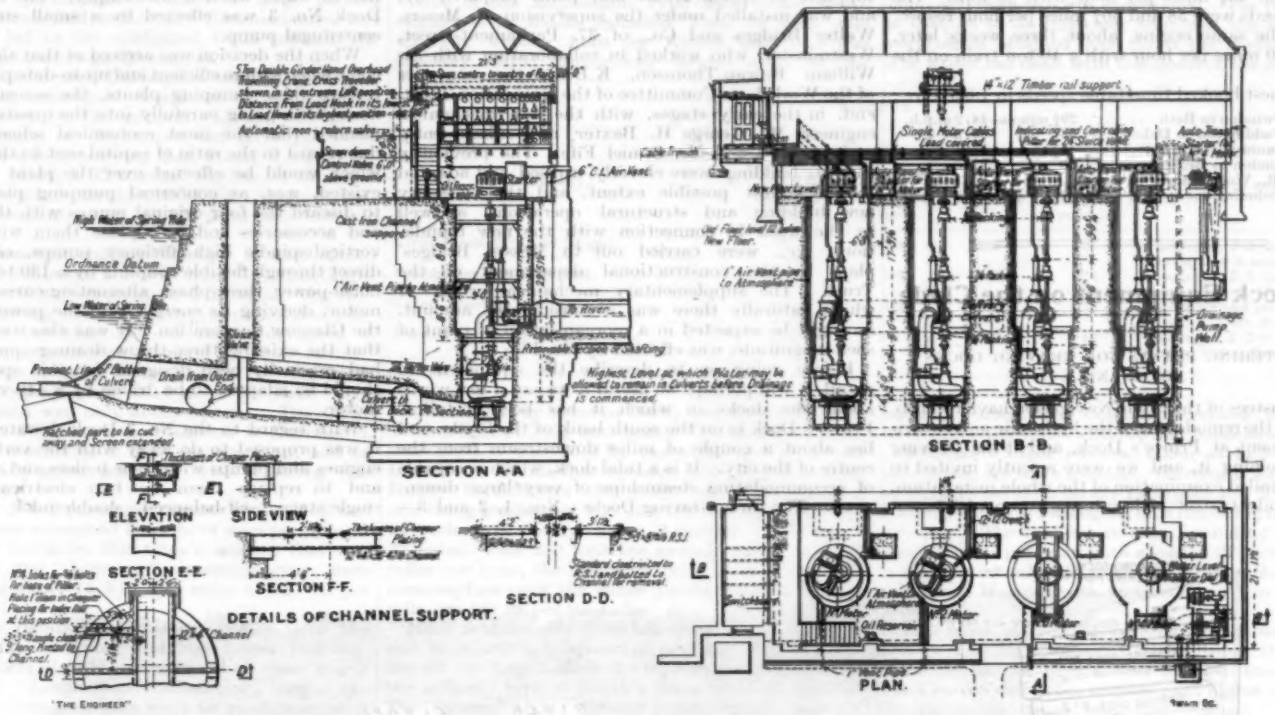


FIG. 2—PLAN AND SECTIONS OF DE-WATERING PUMP HOUSE FOR GRAVING DOCK NO. 1

The pumps are started and stopped by means of push-button automatic control gear of the "Igranic" pattern, and the motors are controlled by auto-transformer type starting switches. The transformers, together with the change-over switches, are enclosed in iron cases fixed to the floor of the pump house. They are of the air-cooled type, and are operated by automatic relay control. The tappings of the transformers are arranged to limit the starting current of the motors to not more than twice the full load current so as to comply with the requirements of the Glasgow Corporation Electricity Department. The solenoids operating the switches are energised from a 440-volt alternating supply, and are controlled by push-button switches fitted in cast iron boxes. Each switch box has a "start" and "stop" position, one switch, in each case, being mounted near the motor, and the other on the main switchboard.

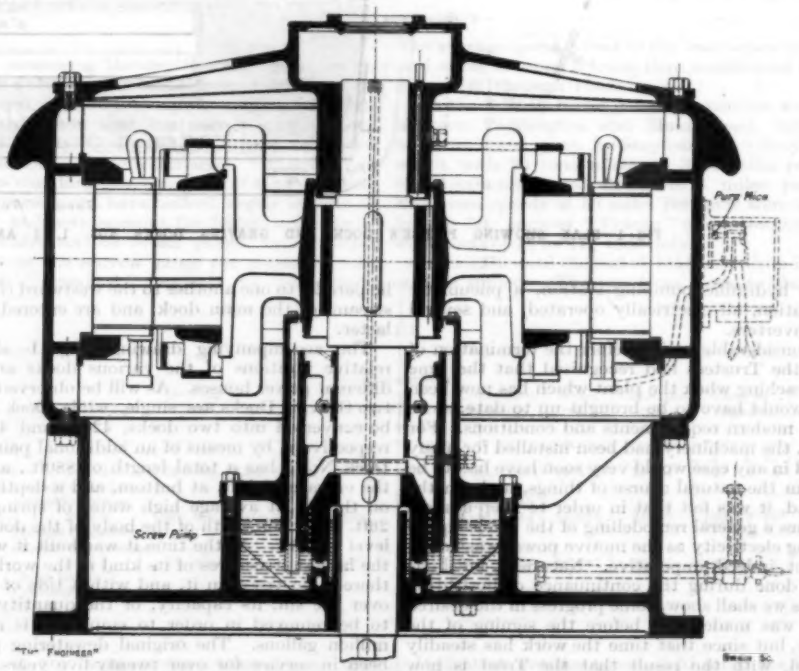


FIG. 4—SECTION OF MOTOR SHOWING SCREW OIL CIRCULATING PUMP

The electrical connections are such that the motors can be started by the switch near the motor and stopped by the other or *vice versâ*, and can also be started and stopped from the same switch.

The three-throw drainage pump is driven by a small 440-volt motor through worm and worm wheel gearing. It can be seen at the far end of Fig. 5 on the right-hand side. The conversion from the old to the present method of driving was carried out by the Mechanical Engineering Department of the Trust, the motor being supplied by the English Electric Company, Limited, the reduction gear by David Brown (Huddersfield), Limited, and the starting switch by Brook, Hirst and Co., Limited. To the left of the pump arranged against the wall is the water level indicator dial, which is operated by means of a float and a wire passing over pulleys.

We were fortunate in that, during our inspection, not only was water let into Dock No. 1, and a vessel which had been overhauled in it floated out, but another vessel was floated in and the dock dewatered. Considerably more than half the contents of the dock was pumped out and the vessel was resting on the chocks in under three-quarters of an hour from the time pumping was commenced. We watched the operation of the pumps for a considerable time and observed it to be excellent. Then, when a temporary stop was made while the vessel was being shored before the dock was finally emptied, we ourselves had an opportunity of starting and stopping one of the pumps several times, by means of the push buttons. The automatic action worked perfectly and with great smoothness. We did the same thing with the three-throw drainage pump which has been fitted with electric drive and worm reduction gear and found that, too, worked exceedingly well.

While the main pumps were running we also had an opportunity of observing the action of the automatic oiling arrangements for the bearings, which was specially specified for the work by Messrs. Bridges, and which we are able to illustrate in Fig. 4.

From this drawing it will be seen that the weight of the rotor is taken on a "Michell" thrust bearing at the bottom of the rotor shaft. This bearing runs in an enclosed oil tank cast in the bed-plate of the motor. The vertical guide bearings of the rotor are lubricated from oil which is lifted by a worm screw on the bearing, the oil passing through the centre of the shaft overflowing into the top oil container and down through the oil ways to the two vertical bearings and so back again to the oil tank of the "Michell" thrust bearing. This method of lubricating has proved most satisfactory taken in conjunction with the Zodel-Voith coupling, which allows of independent alignment and expansion of the vertical shafting between the motors and the pumps. The oiling is quite automatic and requires no attention from the attendant except to look through the glass lid of the oil container on the top of the motors to see that the oil is circulating freely. It will be seen that the lubrication of these vertical bearings by a lifting screw is similar to that of the special bearings specified by the consulting engineers for the vertical connecting shafts.

Report on New Zealand Railways.

On October 18th of last year Viscount Jellicoe, the Governor-General of New Zealand, appointed a Commission comprised of Sir Sam Fay and Sir Vincent Raven, to inquire into and report as to the "financial arrangements, management, equipment and general working, including the administration, control and economy, of the railway service in New Zealand." The Commissioners were desired to send in their report not later than January 31st this year. As a matter of fact, their report, a copy of which has just reached us, is dated December 11th last, and seeing that it is a most voluminous document running probably to between 40,000 and 50,000 words, that it is accompanied by many tables, diagrams, maps, &c., and that the Commissioners found it necessary to travel 4850 miles by railway and 750 miles by motor car, it is amply clear that they must have worked very hard.

The Commissioners point out that, wide though the terms of reference are, they may be summarised under four specific headings, as follows :—

(*a*) Finance ;
(*b*) Organisation ;
(*c*) Management, subdivided into (*i.*) Permanent-Way Works, including proposed new Works, (*ii.*) Signals, (*iii*). Mechanical, (*iv.*) Stores, (*v.*) Operation, (*vi.*) Rates and Fares, (*vii.*) Statistics ;
(*d*) Miscellaneous questions ;

and they proceed to review each of these subjects in the order given. It would be quite impossible for us to deal in detail with their investigations, or even to give a summary of all that was done before they arrived at their conclusions. All that we can do is to refer to those which appear to us to be the most important, or which seem to be of the greatest interest to engineers.

Finance.

Finances were gone into very thoroughly both as regards capital expenditure and running expenses, and also as concerns the result to be anticipated from proposed expenditure on new lines. Among the findings of the Commissioners under this heading are :—

(1) That railway finance be taken out of the control of the Treasury, and the Railway Department be given full control of its own funds.

(2) That the railways be so worked and managed that the gross receipts shall be sufficient to cover working expenses, reserves, and interest on capital, including sinking funds. In the event of there being any surplus, it should be devoted to reductions of rates and fares, and, in the case of a deficit, rates and fares should be increased.

Organisation.

Under the heading "Organisation," the Commissioners suggest that, having regard to the geographical and other aspects of the New Zealand railways, a Railway Board consisting of a Chairman and two other members—one to control mainly commercial affairs and the other competent to direct the operation of the railways—would prove the best type of management. They further suggest the appointment of an Operating and Equipment Assistant, and, in addition to the chief technical officers at headquarters, and recommend the appointment of two General Superintendents, one for the North Island, with headquarters at Auckland, and the other for the South Island with headquarters at Christchurch. These officers, it is proposed, should be responsible directly to the Board, and act under regulations and instructions applicable to the system as a whole, for operation, commercial matters, and maintenance within their respective areas. The keynote of the proposal is the centralisation of principles coupled with the decentralisation of details, which would make for greater economy, more efficient working, and improved relations with freighters and the public.

With regard to the selection and appointment of members of the Board the Report says :—"The desideratum is to secure harmony and team work in its fullest sense at headquarters. This can only be achieved by selecting trained railway men, possessed of vision, zealous in carrying through the reorganisation of the operating, mechanical, and commercial branches, and intent upon bringing the New Zealand railways up to the average world standard of cheap and efficient transport."

In addition to the foregoing it is recommended :—

(*a*) That a Chief Mechanical Engineer, fully qualified and thoroughly conversant with up-to-date methods of railway working, be appointed ;

(*b*) That the number of traffic and civil engineering districts be reduced from nine to six, three in each island ; and

(*c*) That one Divisional Mechanical Engineer in each island is sufficient, and that consideration be given to the question as to whether the North Island Divisional Engineer could not act as assistant to the Chief Mechanical Engineer.

Management.

Permanent-Way and Works.—It is explained that the Permanent-Way and Works Department is controlled by the Chief Engineer, who is stationed at Wellington. There is an Assistant Chief Engineer at Wellington and a headquarters staff of two Inspecting Engineers, a Land Officer, clerks and draughtsmen. So far as the Engineering Department is concerned the system is divided into nine districts—five in the North and four in the South Island. Each of them is in charge of a District Engineer, who has under him an Assistant District Engineer, Inspectors of Permanent-Way, a Foreman of Works, and Bridge Inspectors. The total track mileage for which the Chief Engineer is responsible was at March 31st, 1924, 3942 average single track, including sidings. The percentage of steep gradients on the lines is comparatively high. For the whole of New Zealand the average percentage of gradients is as follows :—

Under 1 in 50	9	per cent. of total mileage
,, 1 in 75	19	,, ,, ,, ,,
,, 1 in 100	25	,, ,, ,, ,,
,, 1 in 200	50	,, ,, ,, ,,

So far as curvature is concerned, of the total mileage 6 per cent. has curves of 10 chains and under, 12 per cent. has curves of 15 chains and under, and a total of 26 per cent. of the track is curved.

The gauge of the track is 3ft. 6in. The rails used are of the Vignole pattern to British Standard Specification. The weights are for main lines 70 lb. per yard—42ft. long ; and for branch lines 55 lb. per yard—36ft. long ; while on the Otira electrified section, between Otira and Arthur's Pass and in the Lyttleton Tunnel 100 lb. rails, 42ft. long, are employed. Rather less than half the total mileage is laid with 70 lb.—or heavier—rails. The Commissioners report that in their opinion the New Zealand railway track is exceedingly well laid, and with regard to the general condition of the lines they say :—"The standard of maintenance on the New Zealand railways is a high one, and the only criticism that could be applied is that on certain of the branch lines it is unusually high." The speeds run, however, are not high. The maximum speed allowed varies from 25 miles an hour on a 5-chain curve to 50 miles an hour on the straight, the general instruction as to speed being as set out in the table given in the next column.

The Chief Engineer, while he carries out deviations and yard improvements, does not construct new lines, that work being in the hands of the Public Works Department. Having regard to the fact that that Department has the plant, equipment and organisation, and that the work is carried out on mainly contract lines under piecework, practically no day labour being used, the Commissioners consider that it would be inadvisable to make any alteration in the existing arrangements. The Chief Engineer was not, until recently, consulted with regard to alignment, and is therefore in no way responsible for curves or gradients or for the cost in deviation to ease gradients, which is going on at present.

Table of Speeds on Curves.

Description of line.	Miles per hour. Express & passenger.	Mixed.	Goods.
On curves 12 to 15 chains radius	25	30	25
On curves 9 to 11 chains radius..	30	25	20
On curves less than 9 chains radius	25	25	20

There are maintenance workshops at Penrose (Auckland District), East Town (Wanganui District), Kaiwarra (Wellington District), Addington (Christchurch District), Dunedin, Invercargill, and Greymouth, and the work carried out at each of these places is described.

Proposed Deviations and other Improvements.

The Report then goes on to discuss the proposed deviation of existing lines and improvements in terminal accommodation, which is to involve an expenditure of £8,081,500, to be spread over the coming eight years. With regard to the deviations and works proposed at and in the neighbourhood of Auckland and Wellington, the Commissioners have no hesitation in confirming the necessity for a rearrangement of approaching lines and of the stations at goods yards at both places. The cost of manipulation of traffic and the running expenses, due in each instance to excessively steep gradients and inadequate station accommodation, account for the meagre return, in many cases, upon traffic conveyed to and from those centres. They consider that the Auckland lay-out could be improved by the provision of a complete through-running station instead of a dead end main line station. At Wellington the proposed lay-out of the station and yard is not justified by the present traffic, and should be carefully studied with a view to meeting requirements from time to time, any additions being in accordance with the complete scheme. The Palmerston North Deviation, the Christchurch and Lyttleton Tunnel works, the proposed new shunting yard at Woolston, and the Rimutaka Deviation are also discussed, the suggestion being made with regard to the latter that, by the use of suitable articulated engines, traffic on the existing line might be quickly and comparatively cheaply expedited.

New Lines.—As concerns the location and order of construction of new lines for developmental purposes, the Commissioners remark that those are questions upon which they do not feel competent to express a decided opinion ; only those who know the country and its possibilities are competent to offer suggestions of value upon such subjects. There is, however, one important link in the chain of railway communication upon which they do think it desirable to express an opinion, and that is the gap between Ward and Parnassus, on the east of the South Island. Between these two points, which are roughly between 70 and 80 miles apart as the crow flies, there is no rail connection at all. "It is not," say the Commissioners, "so much in the local advantage of such a line that we view its completion as of greater importance than some other railways upon which considerable sums have been spent ; it is because of the possibilities offered by its construction of making a complete railway transport system between all parts of the North and South Island without change of carriage in the case of passengers or break of bulk or delay in the incidence of goods traffic that we advocate its construction. . . . With this line in being a train ferry between Picton and Wellington—or, if possible, a bay with sheltered water and easily available by a short railway nearer the South Island—would give all the advantages of throughout rail transit between the two islands. Some day, no doubt, this form of communication will be established. The sooner it is done, looked at from a railway administration point of view only, the earlier will be the time when it will be possible to operate the system as a whole as economically and efficiently as in countries where lines are not disjointed. The public aspect needs but little demonstration."

Signal and Electrical Engineering.

Under the present organisation of the New Zealand Railways the Signal and Electrical Branches are amalgamated under the supervision of a Signal and Electrical Engineer. The technical staff includes an Assistant Signal and Electrical Engineer, a Chief Signal Inspector, a Signal Instruction Assistant, a Superintendent of Signal Shops, and a Chief Draughtsman. The total number of employees in the department is 416, 32 being in the shops and 384 on the outside staff. The Signal and Electrical Engineer is responsible for the installation and maintenance of

all signal interlocking appliances, line wire and poles for telegraph, telephone and safe working instruments, all electrical machinery and lighting—except at Otira—and the overhead gear in connection with the electrified line between Arthur's Pass and Otira. The workshops are situated at Wellington. The establishment is divided into a mechanical and electrical shop and a small test room, and, in spite of the fact that they were not built for the particular work for which they are used, they are, state the Commissioners, sufficient for present-day requirements, though, in consequence of the construction of the new Wellington Station, it is proposed to erect new shops elsewhere.

Of the 3053 route-miles open for traffic there are 1653 miles equipped for block working (tablet), 33¼ miles of double line with block and lock, 8 miles of double and 82 miles of single line with automatic signalling; 198 miles are signalled without block working; 2016 miles of track are signalled, leaving 1037 miles which are unprotected by any form of signal. On these lines the train order system is in operation.

The electrical installation for the lighting of houses, stations, signals, &c., provides for a total lighting and heating load of 1196 kilowatts. Electric motors and dynamos are installed at twenty-five places. In addition, there are five transformer sub-stations. The total number of motors maintained by the Department is 283.

Prior to the time when electric signalling was brought into use, the two-position lower-quadrant mechanical signal, pivoted in the centre, was the standard installation. With the advent of electric signalling, however, the three-position upper-quadrant was brought into operation, and it was immediately followed by the three-position daylight colour-light signal, which, in view of the economy arising from the elimination of all moving parts, has been adopted as a standard type of signal. The standard signal system for single-line working is the absolute permissive block system, the departure signal being at "Danger," while the intermediate signals are normally at "Clear," with the opposing departure signals electrically locked. The signalling and safe-working appliances all over the line are, states the Report, up to modern standards, well maintained and reflect credit on the Department.

The recommendations under this heading are:—

(*a*) That new lines likely to become main lines shall be laid with 70 lb. section rails as a minimum;

(*b*) That consideration be given to the employment of flying gangs for the maintenance of branch lines instead of, as at present, having resident gangs; and

(*c*) That modifications be made in the proposals for improvements and new works essential to cope with present and prospective trade.

Mechanical.

The portion of the Report devoted to this heading is so extensive and detailed that it will be impossible for us to do more than give a brief summary of its contents. It should not be inferred, however, that, because we do not deal with it at length, it is not of importance, for, as a fact, it is, in many respects, the most important part of the Report.

After explaining the constitution and organisation of the *personnel* of the Locomotive Department, the Report goes on to give details of the rolling stock, and it appears that at March 31st, 1924, there were 655 locomotives, 1527 carriages, 461 brake vans, and 25,734 freight vehicles, including service stock. There are no less than 48 classes of locomotives, 73 different kinds of carriages, seven types of brake vans, and 74 different types of wagons.

There are four locomotive works in the North Island and five in the South Island, as follows:—

North Island.—Petone (Wellington), Napier, East Town (Wanganui), and Newmarket (Auckland).

South Island.—Addington (Christchurch), Hillside (Dunedin), Invercargill, Greymouth, and Westport.

In addition, there are small repair shops at Whangarei and Gisborne in the North Island, and at Picton and Nelson in the South Island. A description and map of each of the locomotive works is given, and the general methods of working in the several shops are discussed. We are informed that much of the machinery in the various shops is of an antiquated, if not obsolete, type, and that no progress system dealing with repairs is in force on the New Zealand railways, and the Commissioners remark that they consider that such a system might be introduced with considerable advantage, as it would tend to expedite the completion of repairs, and would enable those responsible to know when particular engines would be ready for service. Furthermore, no system of standard gauges is in force, and, as a consequence, the interchangeability of parts cannot be relied upon. "That," the Commissioners point out, "naturally must be reflected in delays to engines and maintenance cost."

In considering the mileage run by locomotives, the Commissioners state that it is clearly indicated by the statistics laid before them that the engines are in the shops for overhaul and repairs too frequently. Indeed, they state that experience with other railways shows that at least twice as great a distance should be run by the locomotives on the New Zealand railways before they enter the shops. Repairs to engines in New Zealand average a little more than one engine per annum, "while on the North-Eastern Railway of England, the engines, including heavy and light repairs, did not average through the shops more than once in two years, and this without taking into consideration the difference in the character of the traffic working required. If this practice had been carried out in New Zealand, it would mean that not more than 328 engines should have passed through the shops during the twelve months ended March 31st, 1924, whereas in actual fact 677 engines were dealt with." Some of the locomotives in service are of a very antiquated type, and with the large variety of types—forty-eight—standardisation of parts is not practicable, and must add to maintenance costs. The average age of the boilers condemned in New Zealand is 27¾ years, which is far higher than any experience on English or American railways. It compares, in fact, with 16 years in England.

Among the recommendations made under this heading are:—

(i.) That modern machinery be provided in the locomotive workshops and the general arrangements reorganised;

(ii.) That a system of standard gauges be introduced in connection with locomotive maintenance and renewal;

(iii.) That methods of bringing in locomotives for repair be carefully reviewed, to avoid engines being brought in for thorough overhaul too frequently;

(iv.) That the Petone and Addington works could deal with the whole of the locomotive requirements of both Islands;

(v.) That the capital stock of locomotives is sufficient to meet requirements, but the average age is too high;

(vi.) That many of the existing types might be abandoned, and that in addition to the Garratt type referred to above, a powerful type of three-cylinder shunting engine and a three-cylinder express engine with 5ft. 6in. wheels should be introduced;

(vii.) That locomotives be purchased from outside rather than built in the existing shops, which are not laid out to do such work economically.

(viii.) That consideration be given to utilising old classes of engines with one or two vehicles attached instead of ordering special rail motors.

(ix.) That, as the average ages of carriages, brake vans and wagons are all high, indicating a number of obsolete types, the latter be replaced as early as possible.

Conclusion.

The Report concludes with discussions of the questions of (*a*) stores; (*b*) passenger, suburban, tourist, excursion, parcels', and goods' traffic; (*c*) train and wagon loads; (*d*) train control; (*e*) level crossings; (*f*) passenger fares and goods rates and various other matters.

Institution of Mechanical Engineers.

THE seventy-eighth annual general meeting of the Institution of Mechanical Engineers was held in London last Friday evening under the chairmanship of the past year's President, Mr. W. H. Patchell. The annual report, of which we give a summary below, called forth little or no discussion, beyond a grumble at the price charged for the Institution's annual dinner tickets, and a suggestion as to an improvement in the manner of presenting the annual statement of the Institution's finances. Both points were satisfactorily disposed of, and the report was declared carried.

The result of the ballot for the annual election of Council was then announced, as follows:—As President, Sir Vincent L. Raven; as Vice-presidents, Engineer Vice-Admiral Sir George G. Goodwin and Mr. L. St. L. Pendred; as members of Council, Mr. A. E. L. Chorlton, Professor E. G. Coker, Lieut.-Colonel Davidson, Mr. W. P. F. Fanghanel, Mr. James Brown (of Scotts' Shipbuilding and Engineering Company, Greenock), Sir A. J. C. Ross (of Hawthorn, Leslie and Co., Newcastle), and Major S. J. Thompson (of John Thompson Water-Tube Boilers, Wolverhampton). The three last-named gentlemen are newcomers to the Council.

In Sir Vincent Raven's absence abroad, Mr. Patchell continued to act as chairman. Sir Henry Fowler moved a vote of thanks to Mr. Patchell for his indefatigable services during the past year as President. Captain Sankey seconded the motion, which was carried with acclamation. Mr. Patchell, in responding, paid a tribute to the assistance he had received during his year of office from his colleagues on the Council and from General Mowat and his assistants on the secretarial staff.

Summary of the Annual Report.

Membership.—On December 31st, 1924, the membership roll contained 9585 names, showing an increase of 358 over the previous year. It is of interest to note that the number of full members, 3187, is one more than at the end of 1923. The associate members number 4296, an increase of 20, and continue to be the largest class. The associates, of whom there are now 69, have also increased by 20, but the companions, numbering 58, have decreased by 5. The graduates, 1034, and students, 928, show healthy increases of 142 and 179 respectively.

Institution Examinations.—Examinations for entrance to the Institution were held in April and October. The studentship examination was passed by 120 candidates and the associate membership examination, wholly or in part, by 195. It is noted that a new section dealing with the economics of engineering was embodied in the October associate membership examination.

Meetings.—Nine general meetings and four extra-general meetings were held during the year. Ten papers or reports were presented, the remainder of the meetings being devoted to special lectures, &c. Eleven informal meetings were held.

Local Branches.—The five local branches—Glasgow, Midland, North-Western, South Wales and Yorkshire—continued their activities. A new branch—to be known as the Western Branch—has been formed for the counties of Wiltshire, Dorset, Gloucester, Somerset, Devon and Cornwall.

Library.—The Council is gratified by the increasing use being made of the library. During the year, 1889 books were lent and 514 searches were made for special information. A working model of a compound differential pumping engine has been presented by Mr. Henry Davey, and a lathe built by Henry Maudslay 120 years ago has been accepted on loan from the Machine Tool Trades Association. A set of standard-sized photographs of the latest passenger and goods locomotives of the four British railways has been received, and will be kept up to date.

National Certificates and Diplomas.—Under the scheme for the award of National Certificates and Diplomas in Engineering, organised in conjunction with the Board of Education, examinations were held at eighty technical schools and colleges. Of the 1435 candidates who presented themselves, 564 succeeded in gaining ordinary and 166 higher certificates, while 40 gained ordinary and 31 higher diplomas.

Prizes.—The Willans Premium, about £15, was awarded to Mr. P. C. Dewhurst for his paper on "British and American Locomotive Design and Practice." From the Bryan Donkin Fund a grant of £20 was made for research work to Mr. S. J. Davis and another of £17 to Dr. H. Mawson. The Thomas Hawksley Gold Medal was presented to Professor W. T. David for his papers on "The Missing Pressure in Gas Engines" and "Heat Loss in Gas Engines." A Hawksley Premium of £10 was awarded to Dr. H. Moss. The Water Arbitration Prize of £30 was divided equally between Mr. E. B. Ball and Mr. Daniel Fife.

Research Committees.—Work for the Alloys of Iron Research Committee was continued at the National Physical Laboratory. The first results were published in a paper on the relations of iron and oxygen, presented by Dr. Rosenhain before the Iron and Steel Institute, and in a paper on the production of magnesia pots, presented by Mr. Tritton before the Royal Society. Further work has been done on the alloys of iron and chromium and on the preparation of pure chromium and pure manganese. This research is under the charge of a joint committee of various learned societies. For the Cutting Tools Research Committee work was done by Dr. Rosenhain, Dr. Stanton and Professor E. G. Coker. The results of this work have been, or are about to be, communicated at general meetings of the Institution. For the Hardness Tests Research Committee, Mr. G. A. Hankins has been studying the effects of adhesion between the indenting tool and the material in ball and cone indentation hardness tests, and will shortly report his results. A fourth report from the Steam Nozzles Research Committee will shortly be presented on tests conducted with 12 deg. thin and thick impulse nozzles, and with single elementary nozzles. Under joint researches it is recorded that the Marine Oil Engine Trials Committee has now conducted tests on the "Doxford" and the "Camellaird-Fullagar" opposed-piston engines, and shore and sea tests on the engines of four motor vessels. The Committee presented a report on the trials of one of these vessels, the Sycamore, last November, and will submit further reports this year. It is hoped that the final report of the Heat Engine Trials Committee will be ready by the end of this year.

British Engineering Standards Association.—The Council made a grant of £350 to the B.E.S.A. The work of this body, it is recorded, is being hindered by its restricted financial resources.

Finances.—The financial statement for the year reveals a total expenditure of £31,432 7s. 8d., and a total income of £32,334 13s. 9d. It is of interest to note that the Institution Examinations were responsible for an expenditure of £1540 12s., but that a sum of £1423 16s. was recovered by way of examination fees. The national certificates and diplomas cost the Institution £1341 9s. 10d., but here again the fees received, amounting to £1038 5s. 9d., offset the bulk of the expenditure. The printing of the "Proceedings" and *Journal* involved the expenditure of £3673 19s. 11d., but the sale of extra copies brought in the quite gratifying sum of £991 2s. 11d. On research work £1675 4s. 2d. was spent. The meetings cost £1454 16s.,

of which sum more than half, £887 4s. 8d., is set down against the local branches.

ROLLER BEARINGS FOR HEAVY DUTY.

The business of the annual meeting having been disposed of, the discussion was resumed of Mr. J. B. Dahlerus' paper, "Anti-friction Bearing Applications for Heavy Duty." This paper was presented at a meeting of the Institution held on February 6th. We reprinted it in an abridged form in our issue of February 13th.

Sir Henry Fowler, opening the resumed discussion, expressed regret that his position as reporter to the forthcoming International Railway Congress precluded him from revealing on that occasion certain facts and figures in his possession regarding the use of roller bearings on British railways. He could, however, say that those facts and figures did not amount to much, and showed little more than that roller bearings on British railways were still in their infancy. Proceeding, he recalled Sir J. A. F. Aspinall's train resistance experiments of twenty-five years ago, and said that roughly it could be deduced from Sir John's results that on a twenty-coach train the resistance of the journals amounted at 20 miles an hour to about 30 per cent. of the total, at 60 miles to 11 per cent., and at 80 miles to 9 per cent. It was evident, therefore, that at moderately high speeds roller bearings could deal with only a small part of the total train resistance, and it was this fact which produced the result that on long distance, fast trips, such as those between Kentish Town and Leicester, mentioned in the paper, the saving of coal given by the use of roller bearings was small, if there was any at all. He appreciated the advantage which roller bearings conferred in the matter of overcoming friction during the acceleration period. But a well-designed well-lubricated white metal bearing took a lot of beating once there was thoroughly established the phenomenon, whatever it was, that was manifested when white metal and steel moved in contact with each other. Concluding, he called attention to the fact that the Midland Railway tests showed a coal consumption of 0.068 lb. per ton-mile for the plain bearing train, whereas the Finland Railways' test showed a consumption of 0.102 lb. There was a similar difference in the consumptions with the roller-bearing trains, and it was probably to be ascribed to a difference in the quality of the coal used.

Mr. Daniel Adamson said that whereas the author in the opening stages of his paper called prominent attention to the necessity of durability in roller bearings, he did not at any subsequent stage give any comparative data for the life of roller bearings and plain bearings. He also pleaded that more restraint might have been exercised in introducing the names of specific firms into the paper.

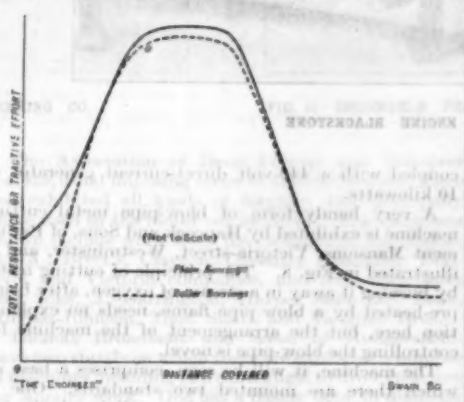
Mr. R. W. Reid, carriage and wagon superintendent, London, Midland and Scottish Railway, Derby, said that the Midland Railway desired to increase the accommodation of its passenger coaches without increasing the size of its locomotives. The results obtained with roller bearings on the Swedish railways provided encouragement to experiment with such bearings with this end in view, but the expectations formed had not been completely fulfilled. He realised, however, that roller bearings possessed other advantages beyond the reduction of running resistance. On the Pennsylvania Railroad the difficulty was to start the very heavy trains that were used. There was no difficulty in keeping the trains going once they were started. If then the use of roller bearings permitted easy starting they formed a good investment. Referring to the excellence of the plain bearings used on the Midland Railway, he remarked that it was essential to use a good white metal, to finish-grind the axles, and to attend to the bearings regularly and thoroughly. His railway had tried roller bearings on porters' trucks, barrows, &c., but had found their cost prohibitive.

Mr. Daniel Fife, mechanical engineer to the Clyde Navigation Trustees, gave some particulars of what he described as the largest ball bearing ever used in this country. This bearing was made in Germany, and was employed to support a shaft, 10in. diameter, on which was mounted a fly-wheel weighing 16 tons, running at 375 revolutions. End thrust proved difficult to handle, and after a year the race became pitted and the balls fractured. The bearing was thereupon replaced by a plain one of white metal. On the same shaft a smaller ball bearing was fitted. This bearing was practically free from end thrust and ran satisfactorily for six years. When it gave out it was replaced by a roller bearing which had been running without trouble since it was fitted.

Mr. J. H. Hyde, of the National Physical Laboratory, said that he had been responsible for the National Physical Laboratory tests on tramway cars, to which reference was made in the paper. It was important, he thought, to make quite clear what a reduction of 80 per cent. in the starting resistance really amounted to. If a curve of total resistance or tractive effort were plotted against space covered from rest, a graph would be obtained for a plain bearing car which differed materially from the graph obtained for a roller bearing car only in the earlier portion—see the accompanying diagram. The work done in bringing the car from rest to its running speed was proportional to the area under the curves, and was clearly not greatly affected even by a reduction of as much as 80 per cent. in the starting effort. He suggested, therefore, that the value of roller bearings for services entailing frequent starts and stops was not so great as had been stated in the paper and the discussion. Criticising the figures for the Kentish Town–Leicester tests on the Midland Railway, he said that as given in the paper they presented very little upon which to form a sound judgment. It was not sound to base an opinion in a matter of this kind on average figures. He himself had found savings of 2 per cent. at one time and 40 per cent. at another under exactly equal conditions. He therefore urged that the Midland figures should not be taken as conclusive.

Mr. J. D. Twinberrow suggested that the resistance of rolling stock might be reduced without the use of roller bearings by simply reducing the diameter of the journals to the minimum consistent with safety. Designers were not always prepared to make such a reduction, but in American practice he estimated that the size of journal commonly used added 10 per cent. to the journal friction without securing any compensating advantage. Regarding the question of end thrust, he remarked that designers were apt to forget that at high speeds the horizontal force might be 16 to 18 per cent. of the weight on the journal. The end thrust should be accommodated by the provision of double collars at each end of the axle so that each of the hornblocks would support end thrust in either direction.

Mr. F. J. Hookham expressed agreement with Mr. Hyde's views as to the variation of results under apparently uniform conditions. He had heard of some tests carried out on the same train, on the same course and on the same day, which gave results which



varied by as much as 30 per cent. The author had presented the Midland figures without attempting to explain or excuse them, but some such variation as he had mentioned would be quite sufficient to reverse their significance. As to the difference between the experience with roller bearings in this country and on the Continent, he thought that the smoother and better tracks possessed by British railways would greatly assist the good behaviour of plain bearings and therefore give roller bearings a reduced chance to show to advantage. As a contribution to the discussion of practical experience with anti-friction bearings, he reported that he was aware of some train lighting dynamos which were fitted with ball bearings. The commutators were found to suffer much more from chatter and wear than did those of similar dynamos having plain bearings.

Lieut.-Colonel A. E. Davidson dealt with the use of roller bearings for the big ends of motor vehicle engine connecting-rods. Many trials, he said, had been made with such bearings, but the difficulty always encountered was the fracturing of the cages. With the author's suggested characteristic of a desirable roller bearing design, namely, that the unit should be non-adjustable, he was in full agreement. In the 1910 War Office specification for subsidy lorries plain floating bushes for the front and rear axles had been specified, although pressure was brought to bear in favour of the adoption of adjustable taper bearings. It had been found in the case of taxi-cabs that no peace was obtained until similar adjustable bearings had been made non-adjustable. During the war many American lorries were supplied with taper roller bearings, which, although they could be adjusted in the workshop, could not be adjusted by the driver on the roadside. This plan seemed to present a reasonable compromise. The self-alignment characteristic which the author also specified as desirable in roller bearings covered a property which, if present, no doubt gave the designer a comfortable feeling, but which otherwise was not of first-class significance. The uncertainty as to the length of life of a roller bearing was a serious factor telling against its adoption. He instanced an example of a pump fitted with such bearings which entailed the necessity for three shifts watching it night and day, because of the complete uncertainty as to when the bearings were going to break down.

Mr. E. Bruce Ball asked for further information regarding the design of roller bearings for heavy loads at slow speeds and for a statement as to the relative advantage of using cages as against the packing of the rollers closely without cages. Engineer Rear-Admiral Skelton said that ball and roller bearings had not been found to give much satisfaction in the Navy. Before the war experiments were conducted on the use of such bearings in thrust blocks, but it was the advent of the Michel bearing which alone made the Hood possible with her 150,000 horse-power. Mr. J. H. Hitchen recounted the success achieved by his firm with the use of roller bearings of a simple design on metre-gauge wagons that had to be pushed by native labour.

Mr. S. C. Croxford said that it was more important to know to what extent a roller bearing could be trusted than to have an exact knowledge as to the saving of power it would effect. A single breakdown might wipe out all the value of the saving effected. He held that neither a ball nor a roller bearing was a mechanically sound device. The bearing between the balls or the rollers and the cage was a point or a line, and therefore a very small load would produce a very high stress. The material not being perfectly hard, deformation of the skin must occur, and the resulting fatigue caused by the repetition of the deformation was such that no metal of which we had knowledge could withstand it. This deforming action was absent in plain bearings, and until it was eliminated from ball and roller bearings it would be impossible to trust them. He also criticised ball and roller bearings on the ground that they were difficult to apply, remove and replace, owing to the fact that they were not split, as were plain bearings, and had therefore to be slipped into place from the end of the shaft.

Mr. G. P. W. Sims said that the paper, in spite of its title, made no reference to anti-friction bearings using rocking pads such as those of the Michel type. In ball and roller bearings final dependence had to be placed upon quality of material. Indeed, he understood that the material used was earmarked for the purpose from its birth onwards. That was not so in Michel and similar bearings, for in such appliances final dependence rested upon a secondary material, namely, the lubricating oil. In ball and roller bearings was there actual metal to metal contact with the race? If there were, what was the function of the lubricant? Did it serve the purpose simply of cooling the parts or was it an anti-corrosion agent?

Mr. J. B. Dahlerus, the author, then replied briefly to some of the points raised during the two discussions. In making comparisons of the saving effected by the use of roller bearings it was necessary to know the relative costs of maintaining roller and plain bearings in good condition. It would, he thought, be interesting to have some figures of that nature from the Midland Railway. In Sweden a two months' test had revealed an economy of 14 per cent., at which rate the increased cost of the roller bearings would be paid back in 4.6 years. It could be definitely stated that the cost of maintaining roller bearings was less than that of maintaining plain bearings. Again, it was undoubtedly true that roller bearings saved the occurrence of hot boxes. In the United States 300,000 miles had been run with roller bearings without a single hot box being found. The first use of roller bearings in the States was made on sleeping coaches simply in order to avoid the disturbance of passengers for a hot box. As regarded the cost of roller bearings, the Midland Railway type illustrated in the paper cost £18 per axle-box, as compared with about £5 for a plain bearing. On the question of trustworthiness, he admitted that there was a fatigue stress in roller and ball bearings, but claimed that recent research work had enabled designers to set the stress and deformation inside the limits required to give a desired life.

NEW WATER AND DRAINAGE PROJECTS FOR SAO PAULO.

THE possibility of a further prolonged drought, similar to that of last summer, has induced the Government of Sao Paulo, Brazil, to proceed with the project for the construction of a new water supply system such as will meet the necessities of the population for the next twenty years. The project comprises the construction of a dam at the waterfall of Graça (Cotia) to form a regulating reservoir which will provide a daily supply of 20½ million gallons of water; and a reservoir at the Cantareira to supply an additional 3,750,000 gallons per day. A further reservoir to contain 3½ million gallons will be constructed on the Serra of Itaberaba for giving a supply to Penha. The excess volume for the basin of Cabuçu will be used by means of a tunnel between the valleys of Ururuquara and Cabuçu. The existing waterworks will be improved and extended, and, when completed, the improvements will serve to supply water for 2,000,000 inhabitants.

The Minister of Agriculture for the State of Sao Paulo has also given instructions for the preparation of final plans, to be submitted to the Department of Water and Sewage, for improvements in the drainage system of the capital. The work contemplated includes the laying of sewers beneath the city and to all sections not yet served; the laying of a system of intercepting sewers; the treatment of the sewage in disposal works to be constructed; the construction of rain-water reservoirs; and the installation of meters in all properties linked to the water supply system.

The estimated cost of these works is 120,000 contos of reis, which would include both the drainage works and the new water supply service. The financing of both schemes is at present occupying the attention of the Secretariat at Sao Paulo.

The British Industries Fair.

No. II.*

THE principal exhibit on the stand of Blackstone and Co., Stamford, is the 55 brake horse-power oil engine illustrated in Fig. 6. This engine is of the cold-starting, heavy oil type and runs at 240 revolutions per minute. Its chief peculiarity lies in the arrangement used for the injection of the fuel, which is so devised that the oil is injected in the same manner regardless of the speed at which the engine is running. The essential parts of the gear are shown in the line

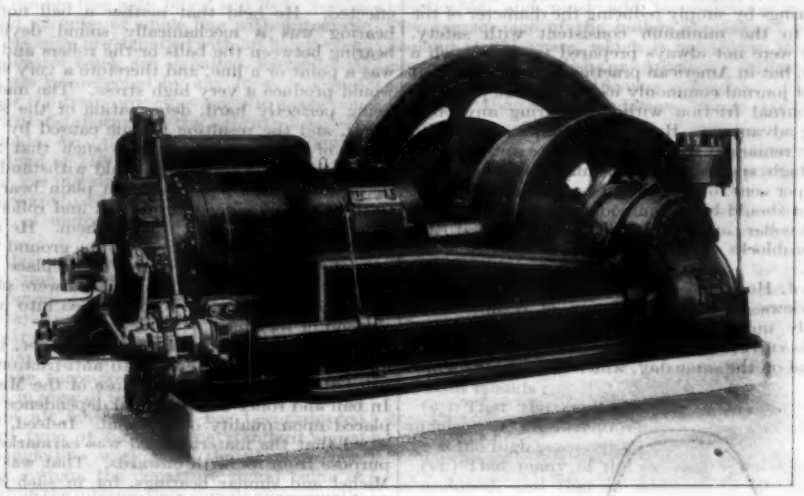


FIG. 6—55 B.H.P. OIL ENGINE—BLACKSTONE

drawing Fig. 7, which is a plan view, with the exception that the cam shaft and rocking lever are shown in a plane at right angles to their proper positions for the sake of clearness.

The fuel oil is supplied by a separate pump to a chamber at the back of the ignition spray and pushes back a small plunger against the pressure of a coiled spring. When the casing has been filled with oil this spring is further compressed by the action of the rocking lever and crank on the end of the cam shaft. The ball valves at the inlet to the chamber then close and the oil is imprisoned under the pressure of the spring, which continues to increase as the crank advances towards the end of its stroke. During this time the fuel valve is kept closed by a coiled spring in its casing and by another spring acting through a bell crank. Just before the dead centre, a pallet on the rocking lever meets the tappet rod of the bell crank and compresses the spring which holds the injection valve shut. The pressure in the chamber then forces the valve open and the fuel is driven, by the main spring, into the combustion chamber in the form of a fine spray. It will be observed that it is the expansion of the spring which injects the oil, and as a consequence the spraying is as effective at starting up as it is when the engine is running at full speed. It is unnecessary to use paraffin in starting the engine and it can be started up from cold with the fuel on which it is to be run. It is also unnecessary to pre-heat the oil before it enters the engine unless it is of such a nature that it cannot otherwise be pumped. The compression pressure of these engines is 350 lb. per square inch and the initial pressure on full load 550 lb., while the mean effective pressure is 100 lb. per square inch. The makers guarantee a fuel consumption of 0.4 lb. per brake horse-power per hour with standard fuel oils. These engines are made in a variety of sizes from 4 brake horse-power up to 150 brake horse-power with single cylinders, and up to 900 horse-power with several cylinders. Another engine on this stand has an output of 17 horse-power when running at 275 revolutions per minute and is coupled with a 440-volt direct-current generator of 10 kilowatts.

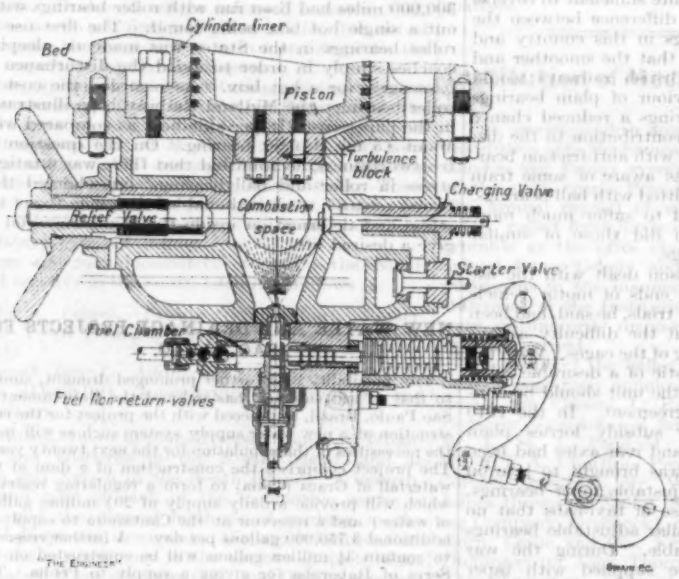


FIG. 7—FUEL INJECTION ARRANGEMENT—BLACKSTONE

A very handy form of blow-pipe metal cutting machine is exhibited by Hancock and Sons, of Parliament Mansions, Victoria-street, Westminster, and is illustrated in Fig. 8. The principle of cutting metal by burning it away in a stream of oxygen, after being pre-heated by a blow-pipe flame, needs no explanation here, but the arrangement of the machine for controlling the blow-pipe is novel.

The machine, it will be seen, comprises a base on which there are mounted two standards. One of these standards carries a table, parallel with the top face of the base, which can be swung to one side so that heavy pieces of work may be lowered on to the base. On the other standard there is a hinged bracket, to the outer end of which two long arms are pivoted. One of the arms is above the table and the other above the work. The lower arm carries the cutting blow-pipe and on the end of the upper arm there is mounted a little knurled wheel, which is driven either by a one-tenth horse-power electric motor, as illustrated, or by clockwork. The knurled wheel can be swivelled in any direction, and it is obvious that it can be made to move the end of the arm about in any path across the table and that the blow-pipe will be made to follow a similar track. Consequently if a full-sized drawing of the shape to be cut is pinned on the table the contour can easily be followed with the wheel and reproduced exactly on the work. Circles can, of course, be cut by fixing the end of the arm by a radius rod and setting the knurled wheel at a tangent.

Apart from its simplicity, the machine has the advantage that the cutting speed is always constant regardless of the direction, while quite sharp corners can be cut out square. The machine is made in two sizes, for cutting up to 5in. thick and 18in. by 16in. area at one setting and for metal up to 12in. thick over an area of 2ft. 6in. by 5ft. The cutting speed is said to be 15ft. a minute through 12in. steel and 100ft. per minute for ¼in. plate.

W. and T. Avery, Limited, of 27, Summer-row,

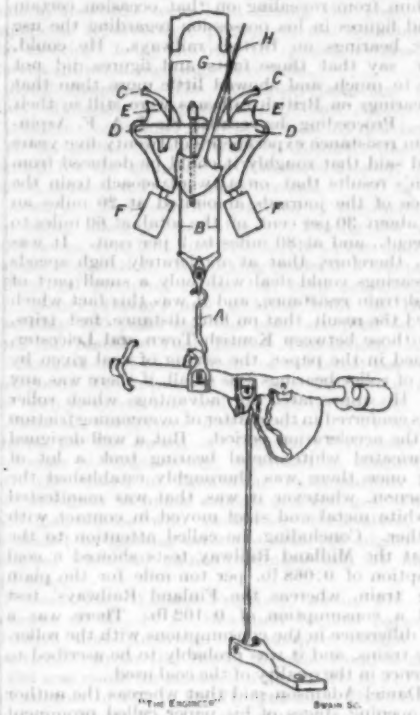


FIG. 9—MECHANISM OF WEIGHING MACHINE—AVERY

Birmingham, have a large stand on which there is displayed a collection of their weighing and testing machines, with most of which our readers are familiar. There is, however, a weighing machine, which we have not yet described, that embodies a rather interesting mechanism. It is of the dial indicating type, and the platform and lever system need little description, as they follow orthodox design. The mechanism used for balancing the load is illustrated in the sketch Fig. 9, and is noteworthy, as it involves only rolling friction. The lower part of the sketch represents the lever system of the platform, which may be passed over. The weight is transmitted by this system to the connecting-rod A, with which two steel ribbons B are connected by means of an equaliser beam. The upper ends of these ribbons are attached to two sector pieces C C, which pivot at D D. Fixed to the axes of these sectors there are two other smaller sectors E E, and the pendulum balance weights F F. The whole system is suspended by the

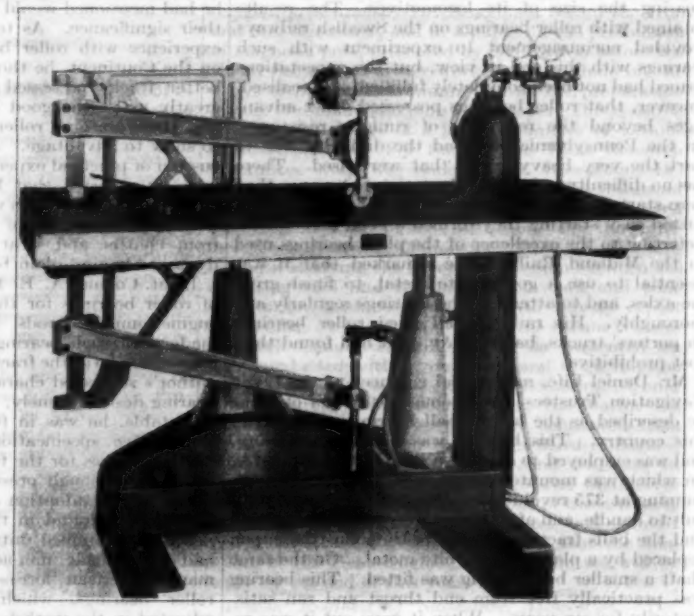


FIG. 8—OXYGAS CUTTING PLANT—HANCOCK

* No. I. appeared February 20th.

ribbons G, which are attached to the sectors E E. It will be seen that as the load pulls down on the connecting-rod the sectors will be rotated until the weights F F balance the pull. In doing so the sectors E E will climb up the ribbons G and, by means of a rack and pinion gear, rotate the pointer H. It is obvious that by properly designing the sectors C C an equally divided scale can be used in conjunction with the pointer.

This mechanism is used on quite a number of the weighbridges on the Avery stand and we found it both sensitive and dead beat.

The lathe illustrated in Fig. 10, which is exhibited by the Exe Engineering Company, Limited, of Exeter, is a development of the little machine described and illustrated in THE ENGINEER of January 11th, 1924, in connection with the Model Engineer Exhibition, which also is on view at the Fair. The new lathe, it will be noticed, is a more substantial machine,

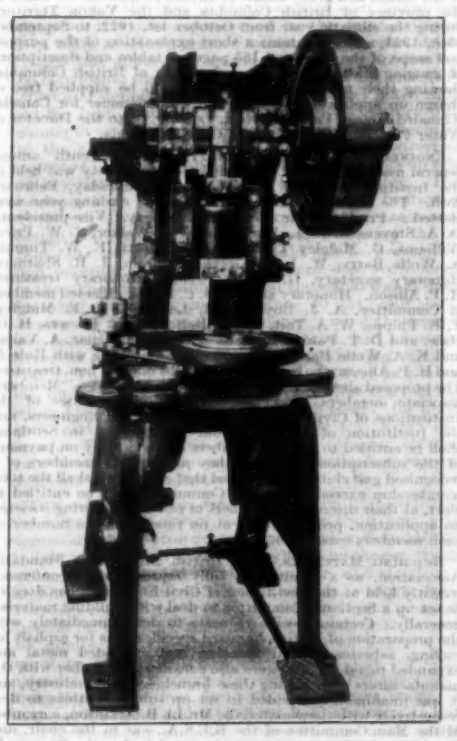


FIG. 12—INCLINABLE PRESS WITH FRICTION FEED

but it retains several of the peculiarities of its prototype. The bed, for instance, is built up of two members, a round bar and a rectangular one, but they are now arranged in a horizontal plane instead of one above the other, as before. The result of this arrangement is that although the lathe is nominally of only 4½in. centres, the space between the two bars allows work as large as 14in. in diameter to be swung between the centres anywhere except over the saddle. The old principle of using a very large speed cone instead of back gears has been retained, and the first wheel of the change gears is connected with the mandrel by means of a dog clutch, so that threads can be picked up with the tool without it being necessary to mark the wheels. The mandrel is bored through with a hole large enought to pass a 1¼in. bar and the headstock can be set over for taper turning, while the back centre is adjustable for the same purpose. The slide rest is of the simple type and can be slewed round to any angle.

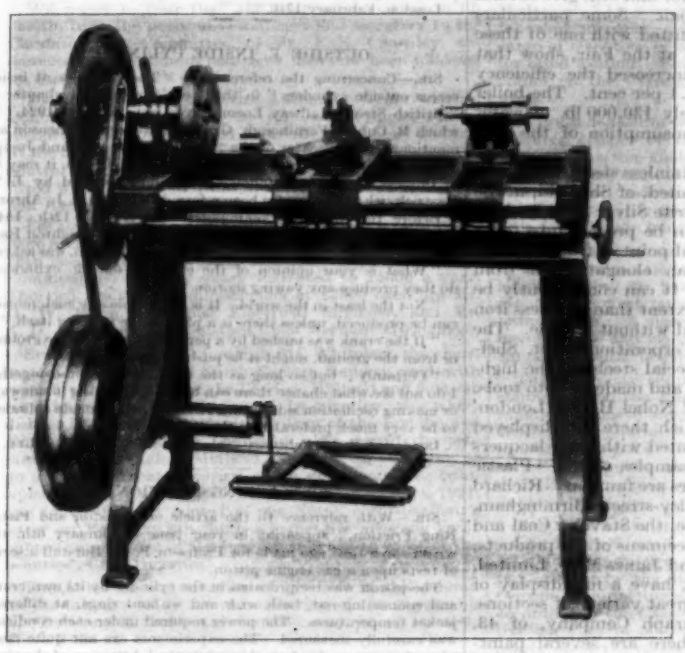


FIG. 10—SCREW CUTTING LATHE—EXE ENGINEERING CO.

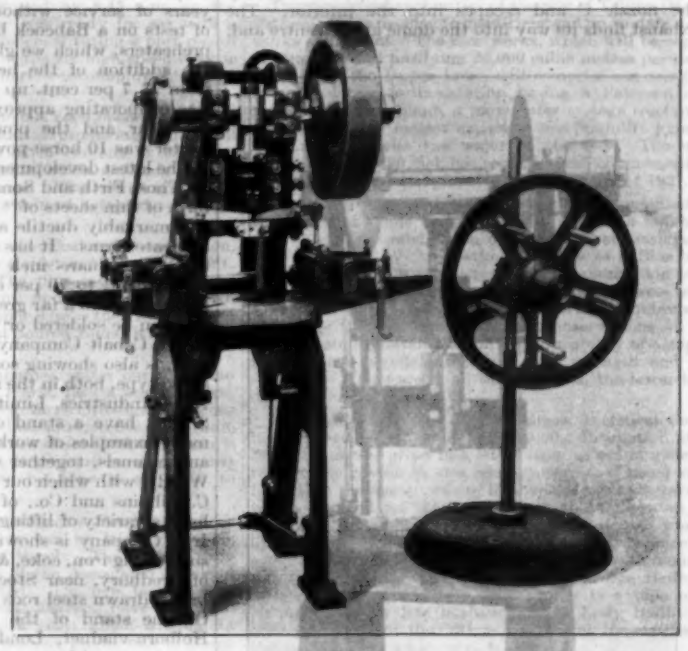


FIG. 11—INCLINABLE PRESS WITH DOUBLE ROLL FEED—BRADLEY & TURTON

The Association of Drop Forgers and Stampers has the usual imposing series of stands on which there are exhibited all kinds of forgings, but principally those used in the motor car industry. The specimens shown include work from the factories of the Albion, B.S.A., Brett's, Clayton, Coventry Stamping, Deritend and Victoria companies, and from Doncaster and Sons, J. Garrington, Harper Sons and Bean, Hughes-Johnson, Thos. Smith and Vaughan Bros.

Thomas Broadbent and Sons, of Huddersfield, have two stands on which there are exhibited a number of machines including two centrifugal hydro-extractors for laundry work. One has a basket 30in. in diameter and is directly driven by an electric motor, while the other is 26in. in diameter and is belt driven. There is also an example of the Broadbent type of friction clutch in which centrifugal action is utilised gradually to connect a motor with its load, so that alternating-current motors can be started up against full load.

One of the most fascinating stands in the whole Fair, from an engineering point of view, is that of Chains (Jewellers), Limited, 37, Albion-street, Birmingham, where there are several machines at work making light chains, such as those used for jewellery, from wire. These machines form and assemble the chain at a speed of from 90 to 120 links a minute, according to the gauge of the wire, but they are of far too complicated a nature to be described within the limits of this notice.

Messrs. Bradley and Turton, Limited, of Caldwell Works, Kidderminster, have a stand on which there are displayed a number of presses and allied machines, some of which are illustrated in Figs. 11 to 14. The press shown in Fig. 11 is of the inclinable type; that is to say, it is pivoted on its standard and can be swung forward so that the finished articles can be easily slid off at the front. The chief characteristic of this machine is the arrangement of the feed rolls, which are duplicated on either side of the table. The top rolls are mounted in rocking frames which are connected with levers that project beneath a lug cast on the ram. The arrangement is such that at the moment when the tool touches the blank material the feed rolls are slightly raised and consequently have no tendency to tear the metal away from the dies. The feed can be adjusted to any length within 3in. The feed rolls can also be put out of action by means of the hand levers shown, and the double feed has, of course, the advantage that the blank metal can be used right up to the end. This machine is equipped with a scrap winder, as shown, which is driven off the feed roll shaft by belt and worm gearing. There is a friction device in the boss of the winder to compensate for the increased rate of take-off as the coil of scrap increases in diameter. These winders produce a good solid mass of scrap, which is much more convenient to handle than the usual loose bundle.

The press illustrated in Fig. 12 is intended for redrawing, piercing, marking, &c., shells which have been previously drawn, and for this purpose is fitted with the dial plate seen in the foreground. The plate, it will be seen, is driven by means of a round belt and is used to carry a stock of shells. The pieces are carried round by the plate until they meet a rocking carrier driven by the vertical shaft, which feeds them into the dies. After being operated on, the shells are automatically ejected. The machine works at a rate of from sixty to eighty pieces a minute.

The small bench press shown in Fig. 13 has been designed with the object of doing the class of work generally assigned to heavy hand-operated screw presses, and the makers claim that it will often increase output by 100 per cent. The ram, it will be seen, is worked by a screw and two friction discs, one for lowering and the other for raising. A slight pressure on the hand lever seen on the right is sufficient to engage the lowering or pressing drive, and as soon as the operation is completed the tappet on the ram engages the lower stop on the vertical spindle, the opposite disc is put into engagement and the ram returns to the top of its stroke. The machine exhibited weighs 8 cwt. without the stand and exerts a pressure of 10 tons, but the firm makes this type for pressures up to 400 tons.

On the same stand there are the rotary shears shown in Fig. 14, which are the smallest size of a

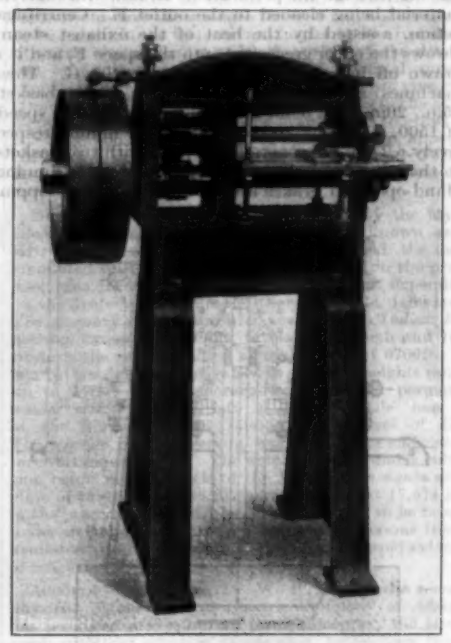


FIG. 13—ROTARY SHEARS—BRADLEY AND TURTON

series that is noteworthy on account of the adjustments provided to allow for the reduction in the diameter of the cutters as they are ground away in sharpening. The bearings for the top cutter can, it will be seen, be raised or lowered and kept parallel with the lower cutter spindle. Two intermediate wheels are arranged between the pinions on the cutter shafts so that the gears may mesh properly as the distance between the centres of the shafts is varied. The table can be adjusted as to height to suit the size of the cutters. The machine shown will cut metal $^{1}/_{16}$in. thick at speeds up to 80ft. per minute.

Industrial Waste Eliminators, Limited, of 20, High Holborn, London, W.C.1, are demonstrating their system of extracting oil from old cotton waste, used

axle-box pads and similar materials, so that both the fabric and the oil can be used over again. One of the chief items in the plant is the centrifugal machine illustrated in the sectional drawing Fig. 15. It will be seen that the machine is of the type in which the basket or cage B is supported from below by a spindle running in ball bearings. Directly beneath the basket there is fixed a turbine disc A fitted with impulse blades. A jet of steam is directed on to the blades by the nozzle C and escapes into the interior. The exhaust finds its way into the dome at the centre and,

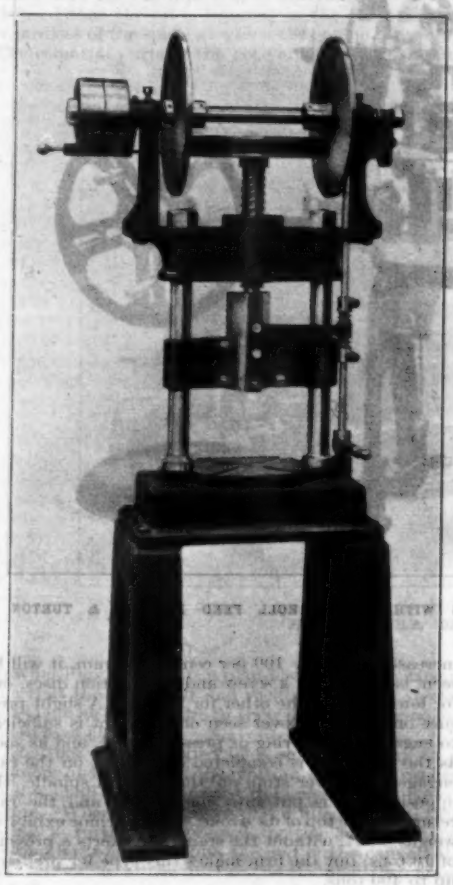


FIG. 14—FRICTION-DRIVEN SCREW PRESS

passing through the perforations D, flows through the material being cleaned to the outlet E. Centrifugal action, assisted by the heat of the exhaust steam, throws the oil or grease out into the space F, and it is drawn off by way of the trap and outlet G. These machines are made in three sizes, with baskets 15in., 20in., and 36in. in diameter, and run at speeds of 1500, 1000, and 700 revolutions per minute respectively. They are generally supplied with two baskets, so that one can be loaded while the other is running. Hand-operated brakes are fitted for quickly stopping

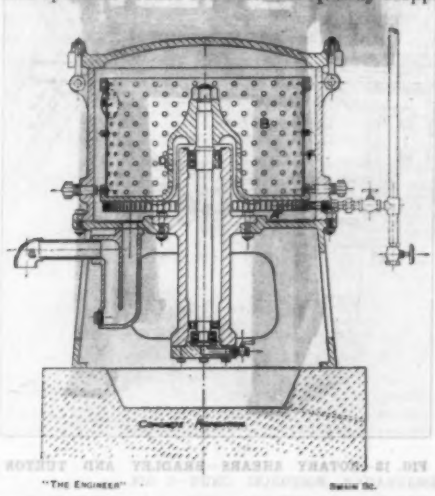


FIG. 15—OIL SEPARATOR—INDUSTRIAL WASTE ELIMINATORS

the machine at the end of the run. The dirty oil drawn off from the centrifugal machine is treated in heated settling tanks to remove the impurities and water.

Howden-Ljungstrom Preheaters, Limited, of 133, Helen-street, Govan, Glasgow, have a stand on which there is shown at work one of the preheaters, for furnace draught, which we have already described and, consequently, it needs little further introduction. The exhibit is, however, noteworthy in that it includes a specimen which demonstrates the fact that the furnace temperatures attained with preheated air need not be detrimental to the grate—a contention brought forward by some engineers who do not advocate air heaters. The exhibit in question is a fire-bar taken from a boiler after it had been in service for some considerable time with the incoming air at a temperature of 700 deg. Fah. It is a plain cast iron bar and shows no indication of burning. The makers say, nevertheless, that they can, if it is so desired, supply bars which will stand a much higher temperature than they can ever be called upon for and still give several years of service without repair. Some particulars of tests on a Babcock boiler fitted with one of these preheaters, which we gleaned at the Fair, show that the addition of the heater increased the efficiency from 77.7 per cent. up to 88.1 per cent. The boiler was evaporating approximately 130,000 lb. of water per hour, and the power consumption of the preheater was 10 horse-power.

The latest development of stainless steel is exhibited by Thos. Firth and Sons, Limited, of Sheffield, in the form of thin sheets of "Staybrite Silver Steel," which is remarkably ductile and can be pressed into quite intricate forms. It has a yield point of from 12 to 15 tons per square inch and an elongation of from 50 per cent. to 70 per cent. It can consequently be cold pressed to a far greater extent than stainless iron and can be soldered or welded without trouble. The Rapid Cobalt Company, of Corporation-street, Sheffield, is also showing some special steels, of the high-speed type, both in the rough and made up into tools. Nobel Industries, Limited, of Nobel House, London, S.W. 1, have a stand on which there are displayed many examples of work executed with their lacquers and enamels, together with samples of the "Plastic Wood," with which our readers are familiar. Richard C. Gibbins and Co., of Berkley-street, Birmingham, have a variety of lifting tackle, the Staveley Coal and Iron Company is showing specimens of its products, such as pig iron, coke, &c.; and James Mills, Limited, of Bredbury, near Stockport, have a fine display of bright-drawn steel rods in a great variety of sections. On the stand of the Aerograph Company, of 43, Holborn-viaduct, London, there are several paint-spraying machines, ranging in size from light little "pistols" up to semi-portable plants for supplying several nozzles.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

MAIN LINE RAILWAY ELECTRIFICATION.

SIR,—All engineers interested in electric traction must have experienced considerable interest and satisfaction in the series of articles you have been publishing on main line electrification by Sir Philip Dawson and Dr. Parker Smith.

The last article, on the Swedish State Railways, is of particular interest, as it deals with the interference with communication circuits from single-phase railways in an authoritative manner, the Swedish State Railways having really endeavoured to tackle the problem.

The results as shown on page 159 will not, I am afraid, be considered very satisfactory by Sir Philip Dawson, but perhaps I may say that they are not surprising to myself, and indeed confirm the opinions I have arrived at from theoretical considerations and from the practical experience on the single-phase line between Lancaster, Morecambe and Heysham.

The removal of the communication circuits in this country to at least 100 m. from the track is, of course, not a practicable solution; to remove them to the minimum distance of even 15 m. is impracticable. This is roughly 50ft.—more than the total width of an ordinary double-line railway!

This minimum distance of 15 m. also necessitates the provision of a compensating circuit, which, I presume, is that covered by my patent No. 15,158 of 1909, and which was tried on the Midi Railway with some success, as described in Monsieur Bachellery's paper last year.

I hesitate to trouble you at length upon what has been so often valued as a secondary consideration in choosing electric traction systems in this country, and it would be interesting to know whether Sir Philip Dawson has not now agreed that for this country the interference question is insoluble with single-phase collection.

J. SAYERS.

Derby, February 23rd.

THE CHITTAPRAT.

SIR,—I have read with great interest the articles published by Mr. E. L. Ahrons on "The History of the British Locomotives." I wish to say that, in course of researches made partly in connection with Mr. Augustin Seguin, I have made some discoveries relating to the Chittaprat—four-cylinder locomotive built by Wilson for the Stockton and Darlington Railway—and to the Stephenson locomotives sent to the St. Etienne-Lyons Railway about 1828, including sketches and drawings of both.

We intend to make publication of the same in due course, and wish to point out that the evidences alluded to modify to a certain extent the statements published, particularly in respect to Chittaprat.

F. ACHARD.

Paris, February 15th.

[We are glad to hear that Monsieur Achard has been fortunate enough to make the discoveries to which he refers, and we hope some day to see a full account of them. In the meantime, in fairness to our own historian, it ought to be said that he quoted Colburn, and was not responsible for an account which, meagre as it is, has hitherto been accepted.—ED. THE E.]

LOCOMOTIVE DEVELOPMENT.

SIR,—May I draw attention to a slight error in Mr. Ahrons' article in the current issue of THE ENGINEER? It is stated on page 179 that the type of forked "small end" introduced by Allen in 1840 was used for all Crewe-built simple engines, both inside and outside cylindered, until the end of Mr. Webb's superintendency. This is, however, not the case. Mr. Webb only used this particular form of crosshead connection when two bar guides were employed, in all other instances beginning with the "18in. goods," Joy's motion, the solid bushed end was introduced together with four guide bars. This arrangement, I may mention, continued for all the compounds of the three-cylinder express classes, and was used for the inside (low-pressure) cylinders of the four-cylinder series. The compound goods engines had two bar guides of another pattern for the outside (high-pressure) cylinders.

E. CECIL POULTNEY.

London, February 17th.

OUTSIDE V. INSIDE CYLINDERS.

SIR,—Concerning the reference to "The question of inside *versus* outside cylinders" in this week's interesting chapter of "British Steam Railway Locomotives from 1825 to 1924," in which B. Cubitt, Fernihough, Gray and Robert Stephenson are mentioned as advocates of the "inside" cylinders, and Joseph Locke as being in favour of the "outside" cylinders, it may be of interest to note the following opinion expressed by J. V. Rastrick, who has recently been referred to by Mr. E. L. Ahrons.

Before the "Gauge Commission" on August 12th, 1845, Rastrick, then chief engineer of the London and Brighton Railway and an advocate of the "narrow-gauge" system, was asked:

"What is your opinion of the effect of outside cylinders; do they produce any yawing motion?"

"Not the least in the world. It is impossible any such motion can be produced, unless there is a play in the framing itself."

"If the crank was pushed by a person standing on the ground, or from the ground, might it be pushed above?"

"Certainly; but so long as the whole is connected together I do not see what chance there can be of its throwing it sideways or making oscillation sideways. I consider the outside cylinders to be very much preferable to the inside cylinders."

London, S.E. 19, February 20th.

ARTHUR LEE.

PISTON RING FRICTION.

SIR,—With reference to the article on "Piston and Piston Ring Friction," appearing in your issue of January 6th, the writer some time ago made for Professor F. W. Burstall a series of tests upon a gas engine piston.

The piston was reciprocated in the cylinder by its own crank and connecting-rod, both with and without rings, at different jacket temperatures. The power required under each condition was carefully measured. The experiments are not quite complete, but appear to show that while the lubrication of the rings is of the boundary type, that of the piston is more nearly perfect. This appears to be in accordance with the generally accepted fact that the friction losses of an internal combustion engine decreases with increase of jacket temperature, a condition which would not hold if boundary lubrication existed for both piston and rings. With the usual crank and connecting-rod arrangement the piston during its reciprocation moves from side to side of the cylinder, and this possibly allows the film to form under the piston.

S. J. ELLIS.

Birmingham, February 6th.

WATER POWER RESOURCES OF CANADA.—The Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has published a new volume of that portion of the series of water resources papers which deals with the surface water supply of the Dominion. This report is No. 43 of the series, and gives details of stream measurements made in the province of British Columbia and the Yukon Territory during the climatic year from October 1st, 1922, to September 30th, 1923, and it contains a short explanation of the purpose and scope of the work and 155 pages of tables and descriptions of gauging stations, with an index map of British Columbia, showing their positions. This report will be supplied free of charge on application to the High Commissioner for Canada, Kinnaird House, Pall Mall East, London, or to the Director of Water Power and Reclamation, Ottawa, Canada.

ENGINEERING GOLFING SOCIETY.—The sixteenth annual general meeting of the Engineering Golfing Society was held at the Institution of Civil Engineers on Wednesday, February 25th. The following office bearers for the ensuing year were elected:—President, Sir Alexander Kennedy. Vice-presidents, D. A. Stevenson, E. L. Mansergh, F. J. Walker, S. W. Price-Williams, G. Midgley Taylor, W. H. Shortt, E. W. Timmis, K. Wolfe Barry, W. L. Mansergh. Captain, J. R. Sharman. Honorary secretary, G. M. C. Taylor. Honorary treasurer, H. P. Allison. Honorary auditor, S. C. Lewis. Elected members of Committee, A. J. Boyd, S. R. Lowcock, H. E. Midgley, F. R. Phipps, W. A. Tait, and F. Bolton, R. E. Dowrn, H. G. Hale, and D. T. Powell, in place of E. C. MacKellar, A. Valon, and K. A. Wolfe Barry, who retire in accordance with Rule 5, and H. P. Allison who is nominated for the office of hon. treasurer. The proposed alteration to Rule 6 was also carried:—"Members, associate members, associates, students or graduates of the Institutions of Civil, Mechanical and Electrical Engineers, and the Institution of Engineers and Shipbuilders in Scotland, shall be entitled to become members of the Society on payment of the subscription, provided they are already members of a recognised golf club, and provided that at no time shall the total membership exceed 175. The Committee shall be entitled to elect, at their discretion, members of other engineering societies on application, provided that at no time shall the number of such members exceed ten."

BUILDING MATERIALS.—The British Engineering Standards Association, as a result of a fully representative conference recently held at the Institution of Civil Engineers, has decided to set up a Sectional Committee to deal with building materials generally. Certain specific requests to deal immediately with the preparation of British standard specifications for asphalt for roofing, asbestos cement sheeting and expanded metal and expanded metal lathing, were also considered, together with the manufacturers representing these branches of the industry, and it was unanimously decided to set up sub-committees to deal respectively with these materials. Mr. L. B. Atkinson, a member of the Main Committee of the B.E.S.A., was in the chair, and representatives were present from municipal authorities, technical institutions and the railway companies, and general users of building materials, various associations and also the Government Departments. A watching brief for the manufacturing interests was held by representatives of the Federation of British Industries, it being obviously impossible for every branch of the manufacturing interests in the building trade to be represented at this meeting. The chairman was careful to explain that there was no intention whatever of the Sectional Committee, if and when set up, initiating any piece of standardisation, or even attempting to set up British standard specifications for any class of building materials without the full support and backing of the particular branch of the building industry concerned. It will therefore be seen that whilst the Sectional Committee is a very representative one, it has not been given a roving mandate, but is to consider each and any request on its specific merits, and to call the manufacturers into conference, both as regards the policy to be adopted and in regard to the technical details of the subject.

Railway Matters.

As from Monday next the boat train for Fleetwood, *en route* to Belfast, will leave Euston at 6.10 p.m., instead of at 5.20, and will be due at Fleetwood at 10.40 instead of 10.25. The 5.20 will continue to run, but will serve only as far as Preston.

We regret to hear that the resignation, owing to ill-health, from the position of manager and secretary to the Cheshire Lines Committee, of Mr. J. E. Charnley, announced in this column last week, has now been followed by that gentleman's death.

Despite the fact that the Automatic Train Control Committee, presided over by Sir John Pringle, recommended that control should be at the stop signal and not at the distant, the Great Western Company, which favours control at the distant, has had forty additional engines fitted with the system it has in operation between London and Reading.

Following on the Fay-Raven report on the railways of New South Wales, noted in THE ENGINEER of December 26th last, Mr. James Fraser has been re-appointed Chief Commissioner and his salary increased to £5000 a year. The two Assistant Commissioners at £2500 each are Mr. O. W. Brain, the Chief Electrical Engineer, and Mr. A. D. J. Forster, the Assistant Chief Mechanical Engineer.

Speaking at a recent meeting, Mr. Whitelaw, the chairman of the London and North-Eastern Railway, said, with regard to the rival Bill of the London, Midland and Scottish for a railway in the Dukeries: "In our view, this whole district is clearly the railway territory of the London and North-Eastern Railway Company. We regard the proposals of the London, Midland and Scottish Company as an invasion of that territory, and a violation of the principles of railway policy upon which the Railways Act, 1921, was founded." As related in our Notts. correspondent's letter on February 6th, both schemes are arousing great opposition, in view of the possible damage to some of the beauties of the Dukeries.

The following amplification of the note in this column on the 6th inst. as to the re-numbering of the engines on the London, Midland and Scottish may be of interest. The Midland engines remain practically unaltered; passenger tender engines take 1–1199; passenger tank engines, 1200–1499 and 2000–2219; goods tank engines, 1500–1999 and 2220–2289; banking engines, 2290–2299; and goods tender engines, 2300–4999. The Western Division A is mainly the old London and North-Western, and its numbers are allotted thus:—Passenger tender engines, 5000–6399; passenger tank engines, 6400–7199; goods tank engines, 7200–7999; goods tender engines, 8000–9999. Western Division B is used mainly by the former Lancashire and Yorkshire Railway. Its numbers are:—Passenger tender engines, 10,000–10,599; passenger tank engines, 10,600–11,199; goods tank engines, 11,200–11,999; goods tender engines, 12,000–13,999. The Northern Division is the Caledonian, Glasgow and South-Western and Highland, and it takes:—Passenger tender engines, 14,000–14,999; passenger tank engines, 15,000–15,999; goods tank engines, 16,000–16,999; goods tender engines, 17,000–17,999.

Although the jury in the Sheriff's Court unanimously acquitted the driver concerned in the fatal collision of July 28th at Haymarket Station, Edinburgh, Sir John Pringle has apparently found no difficulty in coming to the conclusion that the signal was against the train. Both driver and signalman were positive that they acted rightly, and Sir John said he was impressed at his inquiry by the manner in which the driver gave his evidence. Fortunately for the signalman, the section of the line concerned is protected by lock-and-block, which not only has no releasing key but was proved to be in working order. Hence the train that was standing in Haymarket Station prevented the signalman there from giving train-out-of-section for it, and therefore from accepting the next train. As the starting signal could not be lowered until such acceptance was received, there was corroboration for the signalman's statement that the signal was at danger. But that man had broken Rule 40 (*a*), and by not keeping his home signal at "danger," until the train had been brought quite or nearly to a stand, had allowed the driver to get the impression that the starting signal was "off." To complete the misfortune, a driver on the south line, owing to a curve, can see the north line starting signal before his own. That signal was at "clear" for another train, and was evidently accepted by the driver as his signal. The report concludes with offering automatic train control as the most reliable remedy for preventing accidents of that character.

The report by Sir John Pringle on the collision of November 20th between a passenger train and a light engine outside Preston Station was issued on February 20th. A light engine had run round the Whitehouse triangle, rather than be turned on the turntable, and stood on the up line at Whitehouse South Junction, waiting for the crossover-road to be opened, so that it might proceed to Preston on the down line. The signalman said he moved the points and then showed the driver a green hand signal to start. This the latter did; but his engine, instead of going through the crossover, remained on the down line and so met, head on, a passenger train. The driver of the latter and that of the light engine were killed. Such accidents are generally caused by one of two reasons:—(1) The engine does not go far enough, and thus the points are reversed in front instead of behind it; (2) the signalman fails to move the points, and yet gives an all-right signal. Now, the evidence is fairly conclusive that the engine in this case went far enough, and, on the other hand, the signalman was very emphatic that he pulled the lever. There is yet another alternative, and one that has occasionally occurred—the man might have pulled the wrong lever. No. 9 was what he wanted, and either of its adjacent levers—Nos. 8 or 10—were free to be moved. The moral pointed out by Sir John is that the accident could not have happened had there been a signal at the points, as then the driver would not have moved until the signal was lowered and the signal would not clear until the points were set. Attention is again drawn to light engine movements being a comparatively fruitful source of accident in the past.

Notes and Memoranda.

Some experiments carried out in America show that a crowd of men pushing against a balustrade may exert a horizontal pressure of 168 lb. per foot run when they are three deep.

The steamer Age arrived in Newcastle, New South Wales, at 7.15 p.m. recently, and by 8.45 a.m. on the following morning—13 hours—was ready for sea with a cargo of 6000 tons of coal, thus constituting a port record for rapid loading. Four out of the six high-speed electric cranes on the Carrington wharf were employed in the work.

A good deposit of soapstone has been opened up in the Calcutta district of India, and is producing a material which shows, on analysis, a silica content of 63.6 per cent., 32.4 per cent. of magnesium oxide, and only 1.6 per cent. of ferric oxide and alumina. The loss on ignition is 1.8 per cent. It is said that a vein of better material has been found in the mine.

One method of making an electrical earth connection, in use in America, is to place a rivet in the end of a 10ft. length of 1in. gas barrel. The pipe is driven into the ground, the rivet punched out, and the pipe filled with ordinary salt. A piece of copper wire is then forced down into the pipe and white metal poured round it to make a connection with the pipe.

The electricity supply companies, states our American contemporary, the *Electrical World*, face a new problem, rapidly gaining in importance in large cities and populous centres, in the form of power-line interference with radio broadcast reception. In localities where the interference is at its worst public sentiment is growing so rapidly that doubtless something will soon be done in an effort to improve conditions.

The foundation stone of the largest Portland cement works in the United Kingdom will be laid at Bevans, Northfleet, in the first week of March. The work is being put in hand by the directors of the Associated Portland Cement Manufacturers, Limited. The new factory will, according to the *Chemical Trade Journal*, have a productive capacity of 500,000 tons a year, which is equal to nearly one-sixth of the total cement production of Great Britain to-day.

Considerable progress was made during last year in the refining works of the Ural Platinum Trust, which is now in a position to supply any kind of platinum, states a *Rosta Agency* message from Moscow. Consequently, the Commissariat for Finance has decided to operate independently in foreign markets, and to establish direct connections with firms working up platinum in various forms. In this way, it is hoped, it will be possible to lessen the difference between wholesale and retail prices.

A comparative test, mentioned in the *Fuel Economy Review*, of pulverised coal-fired boilers against mechanical stokers and hand-fired boilers gave an increased thermal efficiency of 16 per cent. in favour of the pulverised coal-fired boilers. The powdered coal was the same quality as that employed for the stokers, so not only can cheap coal be used, but less of this cheap coal is required. This improved thermal efficiency increased the actual saving in the seven months in question to about £7600, or at the rate of at least £13,000 per annum, a saving of approximately .12d. per unit kilowatt-hour generated.

The Forest Products Laboratories of the Department of the Interior of Canada have been investigating the problem of the holding power of nails. This feature of nail driving is of high commercial value. Practically all wood construction is dependent upon nails, and there are many kinds of wood being used for building and other woodwork, with the list constantly increasing. Nails, too, vary greatly as regards kind and size. The cut-nail has greater holding power than the wire nail, but is not so easily driven, while the wire nail has its holding power considerably increased when cement coated and barbed.

An interesting experiment in the way of really "central" heating is to be made in Berlin, where, for some time past, attempts at the collective heating of several blocks of buildings from one and the same source has been attempted. The question of expense, hitherto the stumbling-block, has been solved by using by-products. It is calculated that one small power station can heat all buildings connected with it within a radius of 1 to 2 miles, in exactly the same fashion as houses and offices are now lighted and provided with water, light and gas from a common source. It would merely mean decentralising the big power stations and creating many smaller ones, and then utilising the steam which has already been used in the turbines. It is believed that a saving of some 30 per cent. in the way of coals for heating purposes could be effected in buildings already provided with the central heating system by just connecting their plant with the main supply.

Electric lamps for coal miners are rapidly replacing flame safety lamps in America. It is estimated that in the United States about 200,000 electric cap lamps are in use to-day. In 1911 approximately 45,000 flame lamps and no electric lamps were in use in the Pennsylvania bituminous mines, which were then producing 35 per cent. of all the soft coal mined in this country; by 1918 the flame lamps had decreased to 17,000, but the electric lamps totalled nearly 48,000. In Great Britain during the same years the number of flame lamps decreased from 723,934 to 590,185 and the electric lamps increased from 4298 to 156,521. Increased use of electric mine lamps does not eliminate the use of flame safety lamps for gas testing. An experienced man can detect with a safety lamp percentages of gas much lower than the explosive limit, and thus ascertain that a mine atmosphere is becoming unsafe. Also a flame lamp will not burn in an atmosphere that is greatly deficient in oxygen, and thus warns the user to withdraw to a place of safety. For more than three generations, states the annual report of the director of the American Bureau of Mines, the flame lamp has served the mining industry, has made possible the production of millions of tons of coal that could not have been mined without it, and has saved the lives of thousands of miners.

Miscellanea.

Arrangements are being made for the erection of a distilling plant for treating 240 tons of shale a day near Latrobe, Tasmania. The shale is said to contain 40 gallons of oil per ton, and if the first plant is a success it is to be extended to handle 1000 tons a day.

The municipal authorities of the city of Tallinn (Reval), Esthonia, have decided to install new and up-to-date water-works equipment. The new works, which will be capable of pumping and purifying 25,000 cubic metres per day of water from the Upper Lake, will comprise screening and low-lift pumps, sedimentation basins, a Paterson rapid gravity filtration plant, a pure water storage reservoir of over 8000 cubic metres capacity, and high-lift pumping machinery to raise the water to the city. The work, which will cost £90,000, has recently been commenced and is expected to be completed by the summer of 1927.

The report of the informal committee appointed by the Board of Trade to consider and report on bulkheads and water-tight subdivision of passenger steamships has been published by the Stationery Office as a Blue-book. The report includes the history of the examination of the whole subject since 1920, explains the progress made towards international agreement on certain requirements, and gives the Committee's present observations on previous recommendations as to the permeability of compartments, their permissible length, and strength and construction. There are in all three reports, the latest being dated January, 1924.

From an anonymous donor Glasgow Technical College has received a bank draft for £50,000. Intimation of the benefaction was given in a letter from a firm of solicitors read to the governors at a recent meeting, it being stipulated that the money was to be invested, and the revenue to be devoted to the interests of the College at the governors' discretion. The announcement was warmly applauded, and keen appreciation of the benefactor's act was recorded. Another interesting gift announced was from Lady Beilby, widow of Sir George Beilby, a former chairman of the College. This is a pipe organ belonging to her late husband, which Lady Beilby has offered to install in the College hall, paying the expenses of the installation, amounting to £700.

The annual convention of the Engineering Institute of Canada was held in Montreal, January 27th and 28th, the principal topic of discussion being the overcrowded state of the profession and the lack of practical experience of many of its members. The report of the Committee of Apprenticeship and Training strongly emphasised this condition and recommended that young engineers, instead of waiting to obtain responsible and well-paid positions at the outset, should begin at the bottom and obtain practical training in subordinate jobs, either with or without pay, so as to secure a practical training which would qualify them for advancement. This view was forcibly emphasised by several of the speakers. The secretary's report showed a total membership of 5125. Dr. Arthur Surveyer, of Montreal, was re-elected president.

Casualties are reported from the London Zoo, where fog often proves fatal to weakly tropical birds. Nearly all the birds go off their feed through lack of light and sunshine, and their reduced vitality is not improved by sulphurous impurities in the air. Still, a healthy, hungry bird should have the strength to resist fog, and so fogs are to be fought in the tropical bird houses by the installation of quartz electric lamps, which do not cut off the stimulating ultra-violet rays. This form of artificial sunshine should keep the small birds feeding and so give them strength to go on living. Snakes and lizards in the lighted Reptile House laboratory make every effort to crawl into the rays and show signs of recovering their appetites. An electric main is to be laid down the Broad Walk in Regent's Park, and from this the Zoo hopes to bring light to the cages where it is most needed.

During the past year the grant made by the Mysore Government for the Cauvery Dam, now known as the Krishnarajasagara, was Rs. 10.91 lakhs and the outlay amounted to Rs. 9.62 lakhs. Expenditure on the project itself was Rs. 6.73 lakhs, bringing the total expenditure on the project at the close of the year to Rs. 1.00 crores. The masonry of the dam was, according to *Indian Engineering*, extended by 100ft. towards the north and 100ft. towards the south, making a total length of 6700ft. The level of the dam was also raised in places to heights ranging up to 17ft. The temporary weir gap and permanent waste weir gap are left at 80ft., while one weir at the north end was raised to the level of 106ft. The storage in the reservoir was more than sufficient to meet all requirements. The extent of land under cultivation below new channels of the Krishnarajasagara at the close of the year was 18,212 acres, as against 17,574 acres in the preceding year. A large area has still to be brought under irrigation, and the Government is anxious that all available water should be fully used for the rapid extension of irrigation.

According to *Nature*, Dr. W. P Davey, the research physicist of the General Electric Company of America, has produced a crystallised form of copper, the electric conductivity of which is 13 per cent. better than that of ordinary pure electrolytic copper. Professor Bridgman, of Harvard, was the first to discover that copper could be produced in relatively large crystals by the method of slowly heating it in an electric furnace, and then cooling it equally slowly. On December 31st Dr Davey described to the American Physical Society his success in producing copper crystals nearly 1in. in diameter and 6in. long. These specimens could be bent without effort, but once bent they could not be straightened again. This is attributed to the effect produced by the bending in upsetting the balance of the atoms of copper. The crystals seem to readjust themselves into small crystals again, so that for all practical purposes it becomes a bar of ordinary copper, and is equally inflexible. By X-ray examination it was shown that the prepared copper was simply one large crystal, the atoms being arranged in regular rows from end to end. When the crystal was hammered it lost its super-conductivity. The new copper has a greater conductivity than silver.

CLYDE NAVIGATION TRUST—DE-WATERING PLANT FOR GRAVING DOCK NO. 1

WALTER BRIDGES AND CO., WESTMINSTER, ENGINEERS

(*For description see page 233*)

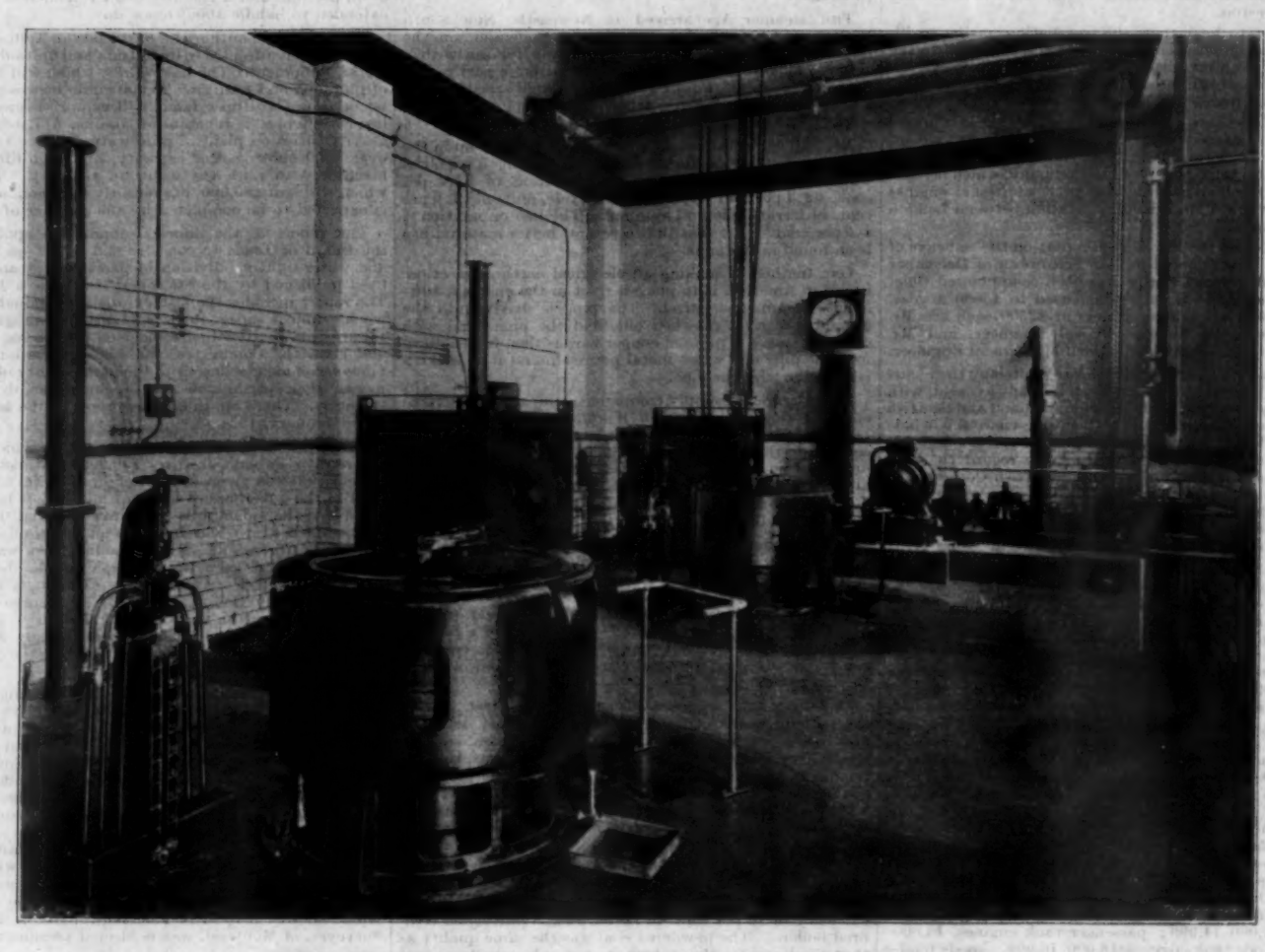


FIG. 5—INTERIOR OF PUMP HOUSE SHOWING MAIN PUMP MOTORS NOS. 3 AND 4

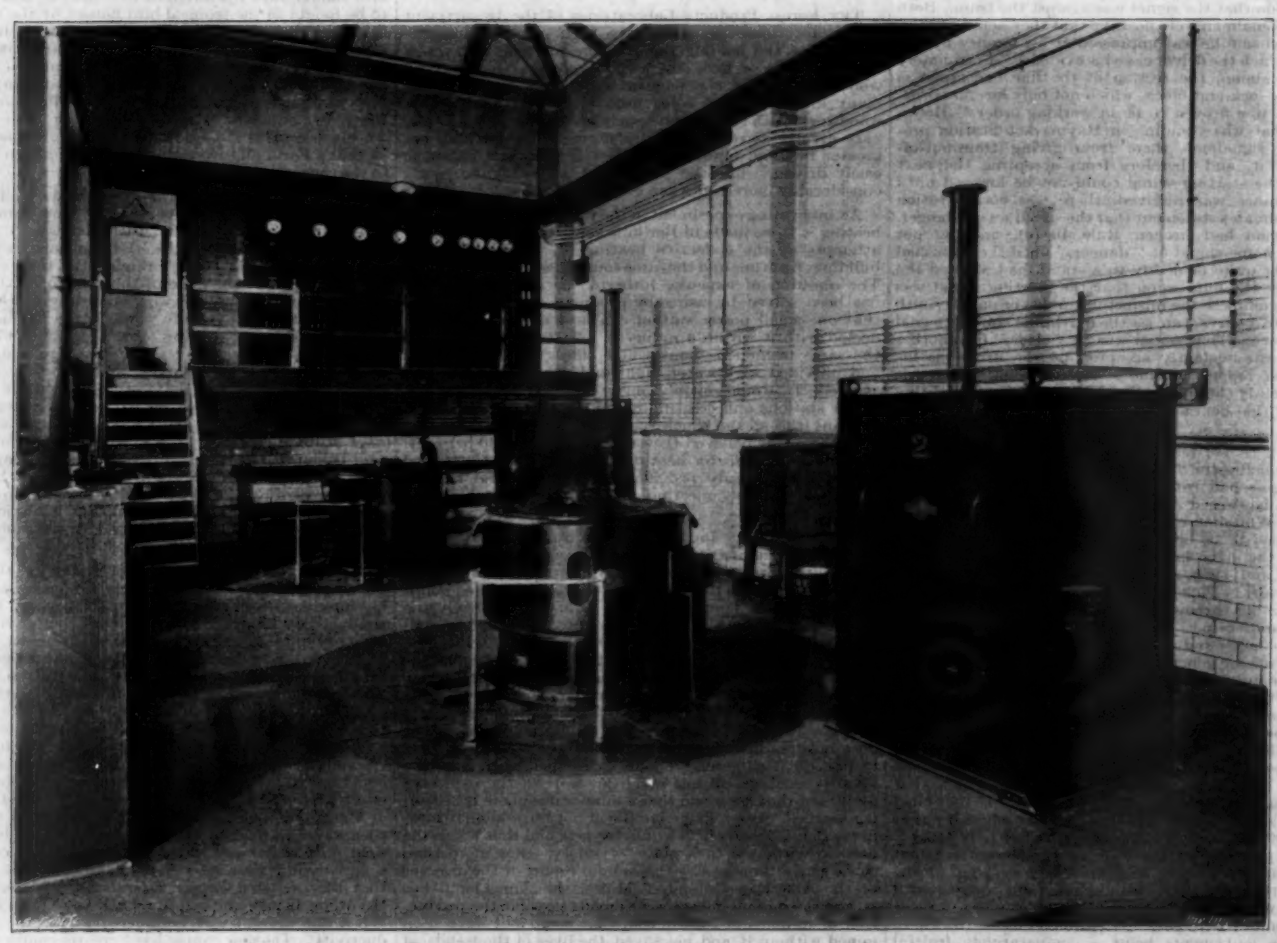


FIG. 6—INTERIOR OF PUMP HOUSE SHOWING MAIN PUMP MOTORS NOS. 1 AND 2

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SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

The Metallurgist

THE FEBRUARY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

DEATH.

On February 19th, at 55, Queen's-road, Aberdeen, JOHN M. HENDERSON, chairman and managing director of John M. Henderson and Co., Limited.

THE ENGINEER.

FEBRUARY 27, 1925.

Roller Bearings for Heavy Loads.

THAT the application of roller bearings under heavy loads presents many interesting and important physical and practical problems, but that a very considerable number of those problems is still unsolved, must, we think, be the general verdict on the case presented in Mr. Dahlerus' recent paper before the Institution of Mechanical Engineers. From the evidence provided by the discussion it is obvious that many engineers have in the past had reason to distrust roller bearings for the support of heavy loads, and that an even greater number in the present are, from experience or by tradition, inclined to shun them or at least view them with suspicion. This attitude on the part of users has undoubtedly arisen from the fact that early patterns of heavy duty roller bearings frequently failed—almost tragically in some instances—to fulfil the claims made for them. It continues in force to-day to some extent because many possible users are unaware of the extensive improvements that have been made in roller bearing design and construction during the past nine or ten years. The attitude has certainly lost some of its justification, but when all the evidence that has been presented to us is reviewed and sifted it cannot yet be said to be wholly out of date. In light of Mr: Dahlerus' very candid presentation of the case for heavy duty roller bearings and the criticism and amplification of it to be found in the discussion, it is evident that these bearings still fall short of constructional perfection, that the benefits to be derived from their use are still open, in many instances, to determination, both as to their nature and amount, and that much uncertainty still prevails concerning their accompanying disadvantages. The most that can, for the present, be said with assurance, is that roller bearings have now reached a stage in their evolution which is such that engineers ought to reconsider and test afresh any adverse judgment they may have formed on their merits as means of supporting heavy loads under a wide variety of conditions.

There is one very important point, fundamental to all applications of roller bearings for heavy duty, about which a precise and authoritative statement would seem imperatively to be required. No attempt has been made to hide or deny the fact that the durability of ball and roller bearings is dependent upon the fatigue-resisting qualities of the materials employed. The area of contact between the balls or rollers and the races is very small. The stress, even for a moderate total load on the bearing, is therefore proportionately high. With each revolution any given point on the race is subjected to repetitions of the stress, the number of which depends upon the number of the balls or rollers in the bearing. In an electric motor running at 720 revolutions, the number of stress applications on any point of the outer race may, according to Mr. Dahlerus, amount to about ten million in twenty-four hours. It is to be inferred that ball bearings can be designed to support this repeated loading with some assurance that ultimate failure by fatigue will not occur, that the stresses applied to the balls and races will not cause the bearing to fail merely by their repetition. With roller bearings, however, the position is different, or so we gather from what Mr. Dahlerus has both written and said. For the present, no general guarantee, we infer, can be given that the applied stresses in roller bearings fall below the fatigue limit. Indeed, in many instances, it would seem, such bearings can only be designed within reasonable dimensions by incurring stresses that exceed the fatigue limit. In such circumstances, the life of the bearing is definitely limited from the outset, and failure will occur after a restricted number of stress repetitions. Experiments on the durability of roller bearings as affected by the fatigue-resisting properties of the materials of which they are constructed are, we understand, in progress. A full and early statement of the results arrived at is greatly to be desired. Lacking it, the average engineer, who likes to know the extent to which trust in the components he uses is justified, cannot be expected to apply roller bearings with confidence. One speaker, on Friday of last week, with some such thoughts as these in his mind, boldly asserted that ball and roller bearings were unmechanical devices. Such statements will continue to be made, to the great prejudice of these appliances, until the true position is established. Having obtained satisfaction on this fundamental point, the engineer contemplating the use of roller bearings for heavy duties will naturally seek definite information regarding the benefits to be derived from their employment. On this subject the position is for the time being scarcely more clear than it is in connection with the question of durability. Increased all-round experience is badly wanted, but from what has already been obtained it would seem that in some highly important applications the chief advantage of using roller bearings is not the obvious one, the reduction of journal friction, but some secondary consequence. On railway rolling stock, for instance, it seems to be definitely established that the use of roller bearing axle-boxes practically eliminates the occurence of hot boxes and all the dislocation which they entail. It is stated that this characteristic provided the prime reason for the adoption of roller bearings on American sleeping coaches, and that the vehicles so fitted have run 300,000 miles without a single hot box being found. The reduction of journal friction would appear to be of secondary importance. Moreover, the evidence as to whether there is any such reduction is not altogether convincing. From Sweden, Finland and elsewhere on the Continent, savings of 11 to 14 per cent. in the coal consumption and up to 90 per cent. in lubricant have been reported following the adoption of roller bearing axle-boxes. But the very careful tests made on the Midland Railway, under conditions almost as comparable as it is possible in practice to secure, failed completely to show any saving of coal, and indeed gave the coal consumption with roller bearings as being more than 8 per cent. greater than with plain white metal bearings. Apart from the reduction or increase of journal friction after the train has acquired a steady speed, we have to consider the effect of roller bearings on the starting resistance, a matter that obviously may be of great practical importance in the case of short distance, stopping trains. The evidence, British and otherwise, would seem to be unanimous in indicating a very considerable reduction in the starting effort when roller bearings are fitted. It is to be noted, however, as Mr. Hyde has pointed out for the case of tramway cars, that the work spent in accelerating

a train from rest is affected by other factors besides journal friction, and that a reduction of even 80 per cent. in the starting resistance produces but a small and quite disproportionate reduction in the energy expended in getting the train up to speed. It may cost as much to start a train from rest as to run it for 50 miles at a steady speed. The bulk of the expenditure is, however, to be ascribed to the effort required to accelerate the mass of the train, and will not be affected by a reduction of the journal resistance even to the vanishing point. Next to the use of heavy-duty roller bearings on railway rolling stock, chief attention has been given to their employment on rolling mills. It would appear that on mills running continuously in one direction, roller bearings save from 30 per cent. of the power when the mills are under load to 70 per cent. when they are running light. The scope for their employment in their ostensible capacity as anti-friction devices is considerable in the case of rolling mills, for as much as 90 per cent. of the power taken to drive the mills may be expended in overcoming the friction at the roll journals. From the results of various tests on rolling mills fitted with roller bearings, it seems that the opportunity provided is not missed. It is not certain, however, whether even in this application the virtue of the roller bearing derives from its friction-reducing capacity. Its virtue may merely be made obvious by the imperfection of the ordinary rolling mill bearing. These bearings, it has been said, cannot be properly lubricated. If they could be, the roller bearing would probably find it difficult to establish and sustain the superiority which is now being accorded to it by certain rolling mill engineers.

Progress in the design of heavy duty roller bearings will no doubt continue, but it will, we think, be almost wholly in the direction of improvement in the mechanical features of the bearings and not in the further reduction of their frictional resistance. There is little or no room left now for such reduction, but there is still wide scope for an improvement in the durability, for the curing of minor defects such as those yet manifested on occasion in the cages and for increasing the ease with which the bearings may be applied to or removed from the parts which they are to support. The development may be slow, particularly in the all-important matter of improving the durability. For the present it would almost seem that the immediate task is not so much to improve the durability as to remove the suspicion that the lack of durability commonly credited to the bearings is fundamental, and that it is a necessary physical consequence of the features on which their anti-friction property depends. Equally important, so we conceive it, is the development of a sound basis of comparison between the ball or roller bearing and the plain oil-lubricated bearing. We have at present little or no knowledge as to whether the mechanical bearing and the oil-borne bearing present two physically different methods of reducing the frictional loss between a rotating shaft and a load applied to it. Analogy would suggest that the balls and rollers may be regarded as replacing the oil molecules when the lubrication is of the boundary type, but analogy in this instance is probably misleading. From all points of view, from the purely practical to the purely theoretical, there is abundant room for the investigation and development of mechanical anti-friction bearings. Mr. Dahlerus' frank account of the present position should do a great deal to clarify the outlook. If he has succeeded in re-opening the minds of engineers to an interest in the subject, and in removing some of the prejudices formed by early unfortunate experiences with roller bearings, he will no doubt regard himself as well repaid for his candour.

Electricity in Mines.

"THE mining industry," said Major E. Ivor David, in a paper read last week before the Institution of Electrical Engineers, "is at the moment very much before the public as a wasteful and unscientific example of private enterprise, so that a few notes on efforts to achieve efficiency and some results of tests made with this end in view may be of interest and may possibly prove that the industry is not so black as it is painted." While some believe that nothing short of nationalisation can make any material difference to those who work in the mines or to the consumers of coal, Major David was able to demonstrate that marked improvements in the operation of mines can be brought about by the utilisation of electricity. Compressed air, however, plays an important part in the working of the South Wales collieries with which the author is concerned, because electricity cannot be used at the working face, and the discussion on the paper very naturally raised the question of whether it should not be possible in the future to employ electricity on a more extensive scale underground. In a modern South Wales colliery in which 2000 tons are raised to the surface per day from a depth of 600–700 yards and in which electrically compressed air is used for cutting, conveying, inbye haulages, and pumps, no fewer than thirty-two units are used per ton of coal raised, and it will therefore be seen that the cost of power is not an inappreciable item in the total cost of gaining the coal, although under different conditions from those prevailing at the particular colliery considered, the power consumption might be very much less. In considering figures of this nature it is well to remember that one of the principal effects of electrification is to reduce at the pit head the amount of unskilled labour and to replace it by a few skilled hands who are very much less difficult to manage. Electrical plant offers the additional advantage of enabling the actual consumption of every machine or group of machines to be continuously recorded and any waste to be checked, whilst the plant also retains its high efficiency without constant adjustment and renewals. The author's results show that whenever accurate records are available, electrification of the machinery at a colliery can be proved to be a sound commercial proposition. The reduction in pithead costs resulting from a highly efficient plant is appreciable, although the total cost of power is small compared with the labour costs at a colliery and the usual method of costing makes it difficult to prove the reductions.

From the point of view of engineers who contemplate electrifying collieries, Major David's paper is of considerable value, for it discusses a number of practical problems that arose in connection with the Powell Duffryn scheme. The author explains, for instance, that he discovered some few years ago that salient pole synchronous motors could be used for driving high-speed two-stage air compressors without employing a friction clutch, the actual starting torque required for these machines having proved to be considerably less than that specified by the manufacturers. Nothing that has been introduced into electrical engineering within comparatively recent years has proved more useful, under certain conditions, than the synchronous motors which can be started with practically the same ease as induction motors. The use of these motors overcomes, or at any rate minimises, the power factor difficulties which at collieries are often very troublesome. Although these motors are now far from new, they are not, in our opinion, always used to the extent they should be, and those who may have any doubt as to their suitability for colliery service would be well advised to consult Major David's paper. As the author has employed salient pole motors for some of his drives, there was a tendency in the discussion on the paper to argue in favour of the cylindrical rotor machine, but the type of motor that should be utilised is surely governed by conditions. Engineers do not argue over the relative merits of squirrel-cage and slip-ring induction motors, for it is perfectly well realised that the type of machine that should be chosen is governed mainly by the starting torque which the particular job demands, and as far as we can see the same consideration applies very largely when dealing with salient pole and cylindrical rotor synchronous motors. Better ground for argument is perhaps to be found in the author's statement that up to a distance of 5 miles compressed air can be transmitted with the same efficiency as electricity. To this statement, however, electrical engineers have, of course, a very good answer, namely, that although the transmission efficiencies in the two cases may be on a par, the conditions are very different when it comes to utilising the power. That electricity is useful in the mining industry is now pretty well agreed, although quite a number of mining engineers seem to doubt whether it is advisable to spend money on electric winders; but as more is done in the way of supplying groups of collieries from a common power station the electric winder will in all probability come into more general use. As Major David shows, if the generating plant supplies a single mine the diversity factor is low, whereas if it supplies a number of mines it is relatively high. For single deep mines therefore the electric winder, which may take anything up to 50 per cent. of the total power of the mine, may not be justified; but if mines can be grouped and their power plants may be interconnected or the power be generated at one or more central power stations, the superior economy of the electric winder can be utilised to the fullest advantage.

Last year it was stated by a well-known authority that only 11 per cent. of the coal raised in England and Wales is cut by electrical machines, and electrical engineers have therefore good reason to wish for a more extensive use of electricity at the working face. The desirability of electric lighting in the roadways and at the working face has often been discussed, for the miner frequently works in semi-darkness. He, however, is a very conservative person, who is not easily induced to take to new schemes, even if it can be shown that they are safe and that if introduced they will facilitate his work. Nevertheless, it is to be hoped that Dr. Thornton's investigations described in a paper which he read before the Institution of Electrical Engineers in 1924 will ultimately lead to better lighting in mines if to nothing else. Dr. Thornton showed, among other things, that if alternating current with a periodicity of 100 cycles per second and at a pressure of 15 volts were used for lighting, ignition of the most explosive mixture, *i.e.*, 10 per cent. of fire-damp, would involve the breaking of a circuit carrying 175 ampères. There should be no special difficulty in increasing the frequency of a small proportion of the power from 50 to 150 periods or even more, but it is, of course, essential before introducing electric lighting into fiery pits to ensure that the results of Dr. Thornton's investigations will hold good under practical working conditions. At a discussion in Glasgow on Dr. Thornton's valuable paper, Mr. F. Anslow referred to a very ingenious scheme which would appear to permit of electric lighting in places where electricity is not generally permitted. The current, he said, was generated at a periodicity of 400 cycles by a small self-contained unit consisting of an air turbine and small generator enclosed in the lamp casing. The unit, Mr. Anslow went on to explain, had been designed so that it could be connected to any underground compressed air system, and it was perfectly safe. Whether this scheme has got beyond the experimental stage we cannot say. The idea, however, seems to be perfectly sound, and, assuming that the miner could be induced to adopt it, it would appear to go a long way towards solving the lighting problem in fiery mines. Good lighting would go a long way towards alleviating the uncongenial conditions in the mine, and incidentally it might possibly make the miner more happy and contented.

Locomotive Engineers.

THE subject of locomotive engineers as such received attention by more than one speaker at the annual dinner of the Institution of Locomotive Engineers, which was held on Friday, February 20th. In the first place, that veteran railwayman, Sir John Aspinall, in proposing the toast of "The Institution," spoke at some length on the all-important matter of training, centring the main point of his remarks on the possible disadvantages which might arise owing to the separation of the mechanical and running departments. Sir John asked if, under this comparatively new order of things, it were possible for young men who were serving their articles in the shops under the chief mechanical engineer to gain running experience on the footplate, and that of repair work in the sheds? This is a very important practical consideration, and we were glad to hear from the president, Mr. J. E. Anderson, that on the London, Midland and Scottish system such training is open to those who desire it. There can be no doubt that, in general, practical footplate work and running shed experience form essential factors in the training of the locomotive engineer, especially when positions abroad are contemplated, and all who have the interest of locomotive engineering at heart must be fully in sympathy with Sir John's remarks. In the past our locomotive men have undoubtedly attained the high position which they hold in the world of engineering, and of that appertaining to locomotives in particular, through the excellence of the all-round tuition they have received in our great railway shops, and the very flattering reference which Mr. W. Whitelaw made to the locomotive engineer must be a source of satisfaction, not only to the men with whom he has been personally associated, but also to those who have been responsible for their education and for the system which in the past has made it possible for men to get so complete a knowledge of their art. Mr. Whitelaw spoke of his long association with railways, and in particular of the number of locomotive engineers with whom he had come into contact, and said "I can safely say I have never been

let down by one of them." That testimony, coming from the chairman of the London and North-Eastern Railway, is certainly something of which the profession may be proud.

The service efficiency of British railways has always been maintained at a high standard. We are, when we consider the great aggregate annual train mileage attained, singularly free from traffic delays which can be attributed in any degree to the failure of our locomotives. This fact in itself is sufficient to show how ably those responsible for our locomotives fulfil their task. The locomotive engineer, like the engine itself, is our servant. Both are at all times in the public eye. The failure of one is immediately reflected in the behaviour of the other. It is only when we experience some unexpected delays on our journeys that we realise the great importance of absolute reliability, which happily for us our locomotive men so fully appreciate. Reliability in service should ever be the chief corner stone upon which is built the main fabric of the motive power department. Fineness in design, and economy in operation and maintenance, are features worth striving after, but it should at all times be remembered that those who provide public facilities are wise not to take risks for the sake of small gains. Our locomotive engineers act on this axiom, and it is chiefly for that reason that we are to repeat again Mr. Whitelaw's words, so seldom "let down."

A Proposed Submarine Tubular Railway.

YET another proposal has been put forward for providing direct railway communication between this country and France. It is the invention of a Frenchman, Commandant J. Veyrier, and was described in the issue for January 3rd of our contemporary, *Le Génie Civil*, from which source the following particulars, as well as the illustrations that accompany them, have been obtained.

The suggestion is to construct two parallel tubes of reinforced concrete supported on a series of piers—see Fig. 1—also of reinforced concrete, sunk to the bed of the Channel and secured in position by means of piles driven through their feet, the piers being made hollow so as to afford access to their interiors. On the line which it is proposed the tubes shall follow, the maximum depth of the water is said to be nowhere greater than 55 m., or about 180ft. 6in. The highest point on the tube structure would come at about 20 m., or, say, 65ft. 6in., below the surface of the sea, which it is considered would provide sufficient cover of water to enable the safe passage over the tubes for vessels of the greatest draught either existing or to be built in the future.

The idea is to sink the piers, which would each weigh 600 tons, at 200 m.—656ft.—apart and some 175 of them would be required. Apparently the tubes are to be all in one piece between the piles, so that they all would have a span of 656ft. When laid in position the inventor proposes to lighten them so that they may be subjected to an upward thrust from the water equal to one-half the maximum rolling load which they would have to carry in service. For a single line of railway the tubes would have to have an internal diameter of 5 m., or, say, 16ft. 5in. Commandant Veyrier calculates that reinforced concrete tubes with that internal diameter would, in order to have zero buoyancy, have to be given a thickness of 0.7 m. The maximum rolling load—if the Decree of January 8th, 1915, be taken as applying—would be 6 tons per lineal metre uniformly distributed. It would therefore be necessary to give the tubes, when erected in position, an added buoyancy of 3 tons per lineal metre. Tubes with a thickness of 30 cm. would be capable of resisting an external pressure resulting from an immersion to a depth of 20 m. or more, but they would have a buoyancy of 12 tons per lineal metre. In order to obtain a buoyancy of only 3 tons per lineal metre it would be necessary to give them an additional weight of 9 tons per lineal metre, and it is proposed to do that by giving them the cross sectional form shown in the left-hand half section in the left-hand top drawing in Fig. 2, a form which, it is remarked, would give them additional strength to withstand such accidental shocks as having a heavy weight, such as an anchor, dropped on to them.

From the illustrations it would appear that it is intended that the piers, at any rate while they are being got into position, should have a shaft projecting upwards above the level of the sea. Otherwise it would seem impossible for the piles to be driven through their feet, for a depth of 180ft. of water is greater than that at which a diver can work for any length of time, even if he could stand the pressure—nearly 80 lb. to the square inch—at all. In any case there would have to be special packing arrangements for the piles to prevent the influx of water.

The sections of tubes, which would have their ends closed and be furnished with adjustable water ballast, would be towed into position by tugs and gradually sunk until they reached the required depth by letting more water into their ballast tanks, and at the same time supporting them from the tugs. The operation of fixing the tubes would, it is explained, be begun in the middle of the Channel and continued both ways towards the coasts. It would therefore appear, though the article from which we are quoting does not say so, that it would be necessary to set the piers and fix sections of tubes alternately, for otherwise the method of fixing which it is proposed should be employed, and which is illustrated in the right-hand drawing in Fig. 2, could not be used.

The shore end, it is suggested, might terminate in a wet dock, which, when the last tube was laid and its passage through the wall of the dock made water-tight, might be pumped out.

The whole scheme is ingenious, but several disadvantages are apparent, the chief of which would be the keeping of the tubes water-tight. Granting that the constructional difficulties could be overcome, there would still remain the fact that there would be some 350 joints, each with a peripheral length of nearly 60ft., and the majority of them subjected to a pressure varying between 30 lb. and 40 lb. per square inch and subjected also to vibration caused by the passage of trains and, near the shore ends, by the action of the waves as well. Then, too, would be the fact that trawlers could not be operated across the lines of the tubes.

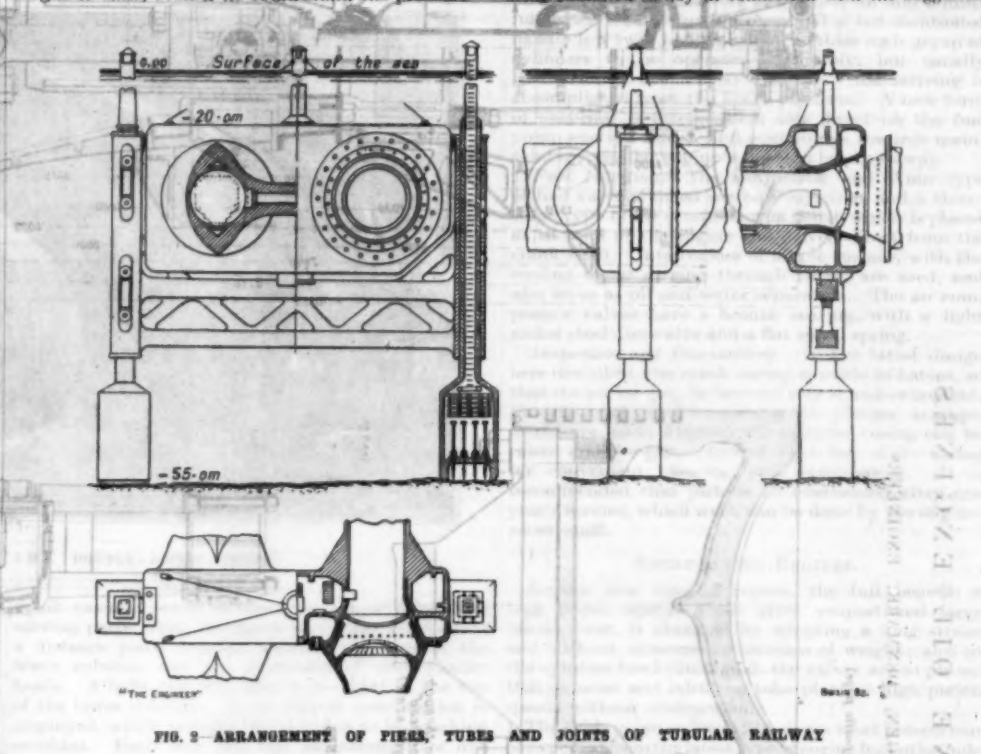


FIG. 2—ARRANGEMENT OF PIERS, TUBES AND JOINTS OF TUBULAR RAILWAY

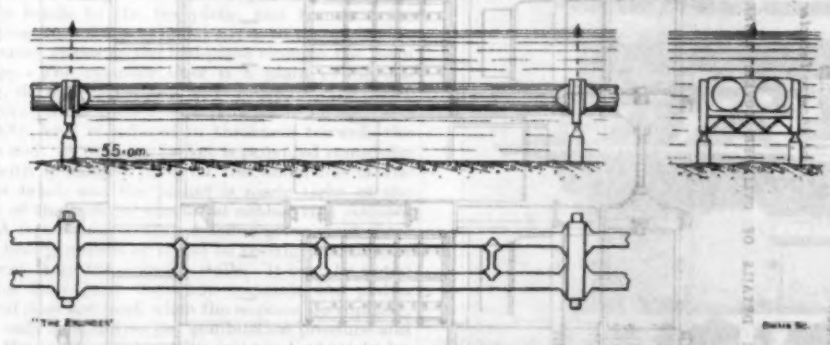


FIG. 1—PART PLAN AND ELEVATION, AND CROSS SECTION OF PROPOSED TUBULAR RAILWAY

SIXTY YEARS AGO.

IN 1865 the old Blackfriars Bridge across the Thames, a fine Portland stone structure begun in 1760 and completed ten years later, was being demolished and a new bridge, the ornamented wrought iron, cast iron, granite, Portland stone "Venetian Gothic" structure, designed by Mr. Joseph Cubitt, which we have with us to-day, was being erected. There was apparently no sentiment shown over the destruction of the relic of the past, such as is being exhibited to-day in connection with the suggested demolition of Waterloo Bridge. On the contrary, it was stated in an article in our issue of February 24th, 1865, that there was nothing to regret in the fact that the old bridge was being removed. The foundations for the piers, it seems, had been formed with few precautions to provide a suitable bed for them. For seventy-five years, however, they gave no trouble. So long as old London Bridge existed its closely spaced "starlings" dammed up the water to such an extent that the scour of the river at Blackfriars, three-quarters of a mile higher up, was rendered innocuous. About 1831 old London Bridge was removed, and the foundations of Blackfriars Bridge began to give trouble by subsiding. One of the arches cracked diagonally through the crown and haunches, and for several years the bridge was in use with the defective arch supported on heavy timber trusses. In its day the old bridge was deemed a magnificent structure, but at the time of its demolition it was described as presenting few points worthy of imitation. Its Portland stone was of the very finest quality, having been taken from veins long since exhausted. But the workmanship generally was poor, the jointing of the voussoirs especially being defective. The haunches were disproportionately heavy, and it was questioned in our article whether the architect who designed it knew anything whatever of the mathematical principles involved in the construction of a stable arch. The bridge cost £151,000, an exceedingly moderate sum even allowing for the higher value of money in the eighteenth century. Its removal presented considerable difficulty. In fact, we doubted whether as much skill, prescience or inventive power would be required for the erection of the new bridge as was being displayed in the removal of the old. Of the new, the existing Blackfriars Bridge, we wrote that its entire design was handsome enough and that it was probable that the bridge might rank on terms of equality with any other on the Thames. That judgment would hardly be repeated to-day, for in Rennie's threatened structure higher up many of those seeking to save it see the finest example of a bridge of its kind in the whole world.

UNIVERSITY OF LONDON: ADVANCED LECTURES IN METALLURGY.—A course of four lectures on "Chemical Combination in Metallic Alloys and its Nature" will be given in the metallurgy department of the Imperial College, Royal School of Mines, Prince Consort-road, South Kensington, S.W. 7, by Professor C. A. Edwards, Professor of Metallurgy at University College, Swansea, at 5.30 on Tuesdays and Wednesdays, March 3rd, 4th, 10th and 11th, 1925. The following is a syllabus of these lectures:—Discussion of some of the physical properties of metals from the point of view of their positions in the periodic table; the electron theory of chemical combination and its application to alloys; absorption of gases by, and their solution in solid and liquid metals; the diffusion of gases through metals at ordinary temperatures, and a consideration of the mechanism of these processes; the influence of diffusion on recrystallisation, and the migration of undissolved constituents in alloys; the nature of solid solutions and the effects of equiatomic proportions of added elements on the electrical conductivity and hardness of alloys. The lectures, which will be illustrated with lantern slides, are addressed to students of the University and to others interested in the subject. Admission free, without ticket.

FOUR-CYCLE MARINE OIL ENGINES

BURMEISTER AND WAIN, COPENHAGEN, DENMARK, ENGINEERS

(For description see opposite page)

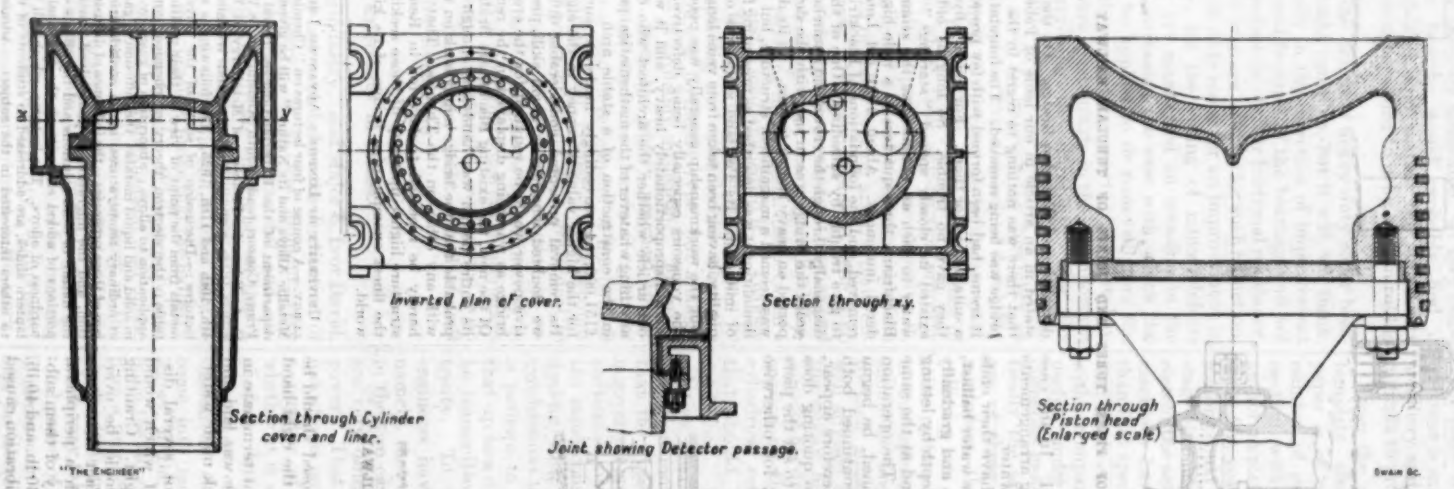

Inverted plan of cover.
Section through x.y.
Section through Cylinder cover and liner.
Joint showing Detector passage.
Section through Piston head (Enlarged scale)
"The Engineer"

FIG. 1 DETAILS OF CYLINDER COVER, LINER AND PISTON FOR SINGLE-ACTING ENGINES

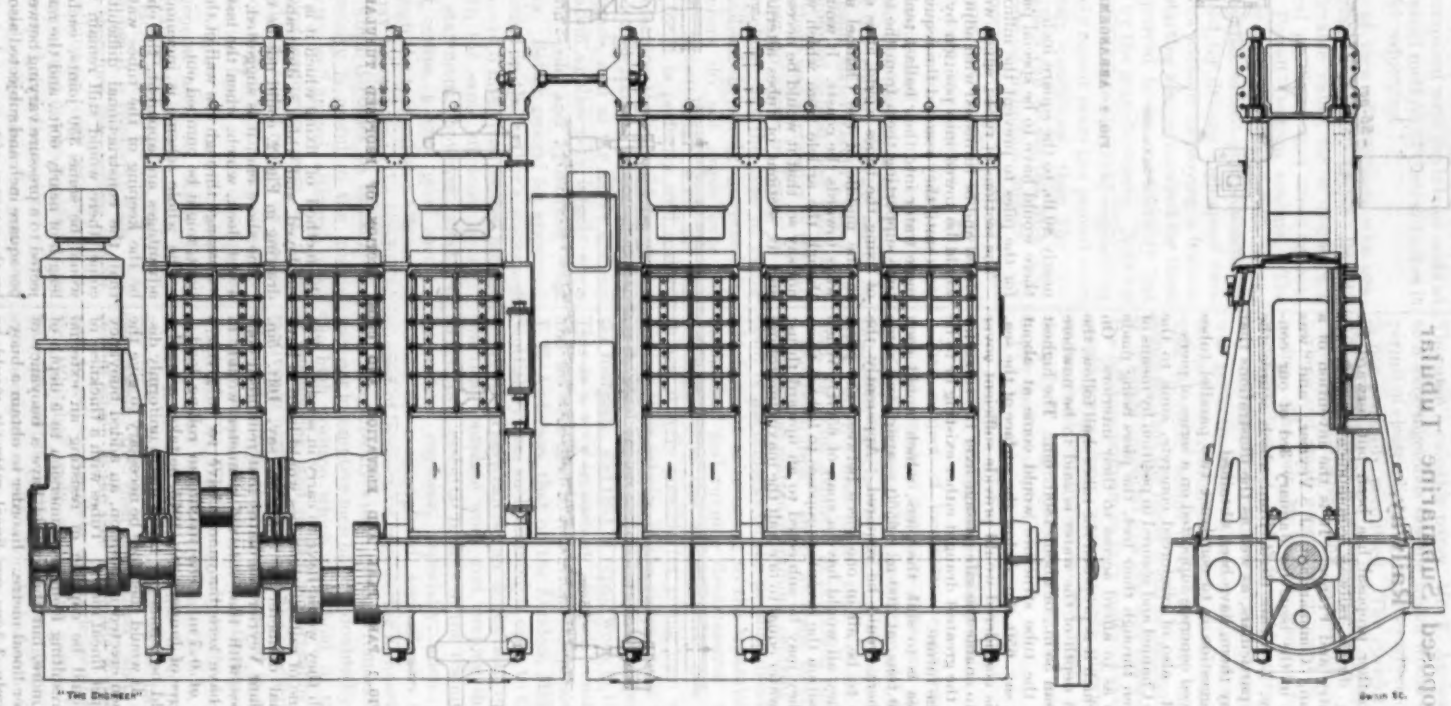


FIG. 2 GENERAL ARRANGEMENT OF SIX-CYLINDER SINGLE-ACTING ENGINE

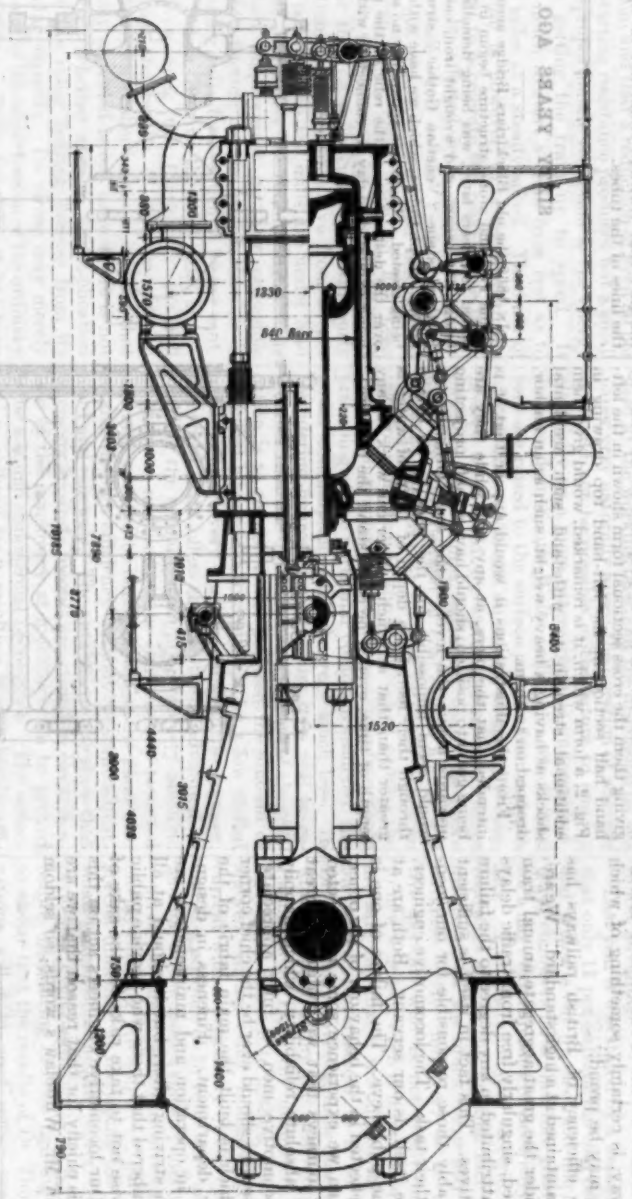


FIG. 3 SECTIONS OF DOUBLE-ACTING ENGINE

The Four-cycle Marine Oil Engine.*

THIS paper deals with the latest type of Burmeister and Wain oil engine, the first single-acting four-stroke engine of which type was completed about 1920 and has since yielded excellent results under test. The author's opinion is that a main oil engine plant must be run for at least three years in order to ascertain its qualities, and that the third year decides whether the installation is good or indifferent. Results obtained on trial trips and maiden voyages are practically of no use without a very critical investigation of the machinery.

FIG. 4 CRANKSHAFT FOR 6750 S.H.P. DOUBLE-ACTING ENGINE

DETAILS OF DESIGN.

Cylinder Head and Liners.—The cylinder cover shown in Fig. 1, page 246, has a flat top with vertical sides, and open bottom, corresponding with the cooling water jacket. It can be cast in a convenient manner and is easily cleaned. The bottom of the cylinder and the part which does not act as a wearing surface is cast in one with the head, and is ribbed to the upper part of the vertical sides by four flat webs. It will be appreciated that the bottom of the cylinder and its upper part can expand freely out from the fixed centres formed by the valve bosses. The four valves—for exhaust, inlet, starting, and fuel—are arranged within the cylinder bore, but are offset from the centre, so that there is a good distance between the valves, and contact casting stresses are not set up. In all the engines built since 1920 with this type of head, no cracked cylinder cover has been experienced. The covers are grouped together in threes and fours for the six and eight-cylinder units respectively—see Fig. 2—and the two inner cylinder heads are coupled together by steel stays. Steel stay bolts pass down through the joints between the cylinder heads to the bed-plate, and transmit the total pressures on the cylinder cover to the underside of the cross girder of the bed-plate close to the main bearings. The cylinder liner is a plain cylindrical casting, flanged at the top and secured to the cover by screws. It is turned smooth both internally and externally, and is reduced in thickness towards the bottom end. A cylinder jacket is provided round the liner, with a flanged joint on the underside of the cylinder head, and the jacket is made tight at the bottom of the liner by the usual rubber ring connection. A free water cooling space is given, and there are no heavy masses of metal to restrict the flow of heat away from the cylinder walls. It may be noted that the liner joint does not transmit the piston load, and does not work when the engines are running, as it is only exposed to the combustion pressure and that of the cooling water. This joint is made tight by two faced and ground spigots, and with a view to obtaining effective control over the tightness of this flange, which cannot be watched from the outside, a detector hole—shown in Fig. 1—is bored into the recess between the spigots and communicates with the atmosphere. Any failure, either from the combustion or water sides, is thus quickly detected.

Pistons.—The piston—also shown in section in Fig. 1—has a concave crown, and is secured to the piston-rod flange by heavy studs. Such a design enables the load to be transmitted from the piston to the rod without bending the piston wall. The piston rings are placed close down near the flange and the lower ring is arranged as a scraper ring. When the crown is subjected to the high temperature of the combustion gases, it will tend to be distorted, as shown by the dotted lines, namely, lifted in the centre and expanded at the top. In view of these stresses, the head has a conical top with walls of equal thickness. All the rings are fitted to that part of the piston not subjected to deformation, so that a very small clearance between the piston and cylinder can be used. The lubricating oil enters at the bottom end of the liner and the lubricators are so arranged that the piston receives its charge of oil in the bottom position, the scraping ring carrying the oil upward and distributing it over the cylinder walls. The pistons can be arranged either for oil or water cooling.

Crank Casing and Columns.—The main columns are in two parts—see Fig. 2—the lower part forming the crank casing, which encloses the forced lubricated moving parts, while the upper part takes the form of a distance piece inserted between the tops of the lower columns and the underside of the cylinder heads. A light cast iron tray is provided at the top of the lower columns. A tee-shaped cross section is employed, which permits the columns to be machine moulded. Each stay bolt has an intermediate nut which fits into a recess in the cylinder head at the top of the distance pieces. This nut is used to give initial tension to the bolts during erection, while the topmost nut secures the cylinder heads. By employing the design outlined above it has been possible to build light engines with a very long stroke. With such engines, suitable piston speed and horse-power is obtained with low revolutions, enabling the ordinary propeller for slow-running single-screw cargo ships to be used. Small engines have a stroke 2.5 times the cylinder bore, and larger engines twice the cylinder bore. These long-stroke engines are characterised by exceptionally good combustion, low temperature of exhaust gases and a fuel consumption of 0.278 lb. of oil per indicated horse-power hour. In the Burmeister and Wain engine cylinder diameters have been standardised and the stroke-bore ratio is varied to suit the requirements of different ships. The crank shafts are built-up like that, as shown in Fig. 4.

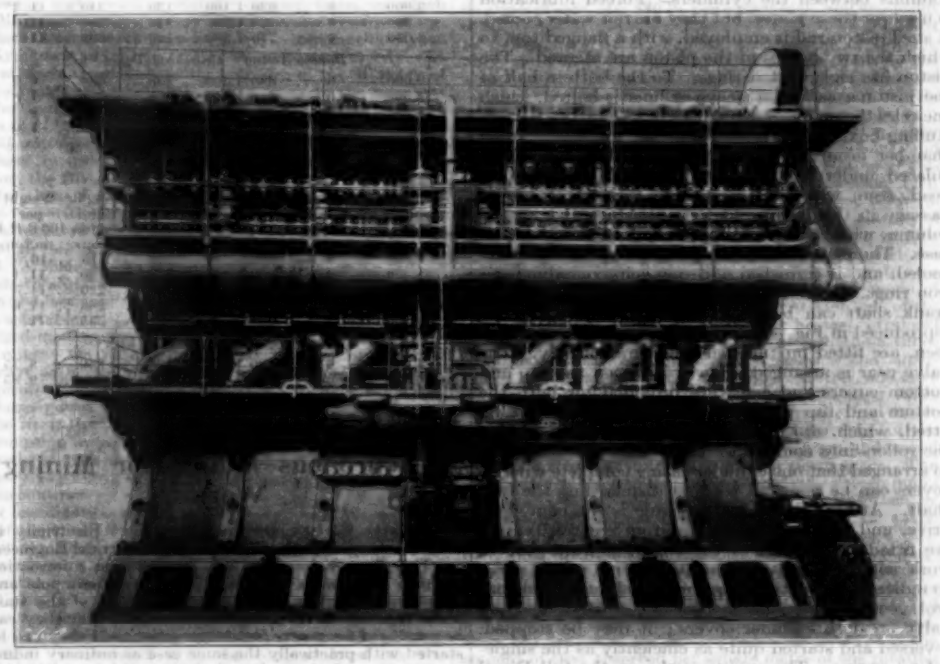


FIG. 5—6750 S.H.P. DOUBLE-ACTING ENGINE FOR THE MOTOR LINER GRIPSHOLM

As shown in Fig. 2, the gear for the cam-shaft drive is placed at the centre of the engine between the two groups of cylinders, and is enclosed, with the fuel pumps and manœuvring gear placed at the front of the columns. It may be noticed that the main bearings are kept short, the length being fixed with a view to obtaining ample space for both the stay bolts and the main bearing bolts, and to ensure that the evenly distributed load is not interfered with by shaft deflection. No undue wear of bearing has been recorded.

Manœuvring and Governing Gear.—Manœuvring takes place by manipulating two handles, one to adjust the engine for ahead or astern position, and one which admits starting air, cuts it off and admits fuel when thrown further over. This last-mentioned handle is a twin handle, which enables each group of cylinders to be operated separately, but usually both handles are moved together. Manœuvring is accomplished from the lower platform. A new form of governor is fitted, which acts direct on the fuel pump suction valves, and contributes towards maintaining a regular engine speed in a heavy seaway.

Fuel Injection.—The Burmeister and Wain type of fuel valve is fitted with air injection, and a three-stage type of air compressor is fitted, which is placed at the end of the engine and driven direct from the crank shaft. Intercoolers of ample surface, with the cooling water passing through tubes, are used, and also serve as oil and water separators. The air compressor valves have a bronze seating, with a light nickel steel disc valve and a flat spiral spring.

Inspection and Dismantling.—In the latest design here described, the crank casing is made in halves, so that the piston may be lowered into it and swung out. For the purpose of examining the pistons, arrangements are made whereby the cylinder casing can be raised and the piston turned down free of the casing for convenient cleaning and examination. It is recommended that pistons be overhauled after one year's service, which work can be done by the engine-room staff.

SINGLE-ACTING ENGINES.

In the new type of engine, the full benefit of high piston speed, which gives proportional large horse-power, is obtained by adopting a long stroke and without unnecessary increase of weight; also in the cylinder head illustrated, the valves are so placed that exhaust and inlet can take place at high piston speeds without obstruction.

The table given on page 248 shows what powers can be expected from the latest type of engine for both single and twin-screw installations. The figures tabulated are not those obtained on a short trial trip, but are powers which will be developed under normal conditions at sea. By employing supercharging, the powers given in the table may be increased by 10 per cent. and over. The smaller sizes of engine are of the trunk type without crossheads, and with these engines the lubricating oil required has, by use of special rings, been reduced to 1 gramme per indicated horse-power for the main engines, including all the oil used in the engine-room and on the tunnel bearings. For the crosshead type of engine the mean consumption of lubricating oil is about 0.60 grammes per indicated horse-power per hour inclusive.

DOUBLE-ACTING ENGINES.

In collaboration with Harland and Wolff, Limited, Burmeister and Wain recently built an experimental double-acting four-stroke cycle engine, designed to

* Summary of a paper read by Mr. H. H. Blache before the Institution of Engineers and Shipbuilders in Scotland, February 24th, 1925.

develop 1000 brake horse-power in a single cylinder. The results obtained were so satisfactory that further designs of both six and eight-cylinder engines of this type were immediately proceeded with. Fig. 3 is a bastard sectional elevation of this type of engine. The leading dimensions are given in millimetres. The difficulty of arranging suitable combustion space around the piston-rod at the bottom cover is overcome by providing a special combustion chamber at the side of the cover. It will be seen that this cover has a spherical internal face, which at bottom stroke practically coincides with the bottom end of the piston. On its under side, a central space for the stuffing-box is provided. The actual combustion space has small and slightly curved surfaces. At the bottom of it the vertical non-water-cooled exhaust valve is placed, while above is the air inlet valve arranged on an oblique position, and between these valves the fuel and starting air valves are grouped. Between the fuel valve and the piston-rod sufficient distance is left, so that the fuel spray cannot strike the piston-rod direct. In general the cylinder liner is similar to that used on the single-acting type of engine, and is jointed by flanges to the top and bottom covers, a detecting device for joint tightness—see Fig. 1—being fitted to both flanges. The piston rings do not pass beyond the top of the liner, and the cylinder head space above this is filled by the piston crown. Through stay bolts, made in two parts and joined by long nuts, which rest on the top of the bottom cover, are used. As these bolts pass right through the engine, a firm and rigid structure is obtained. During erection, the bottom halves of the bolts are given the initial tension required by tightening up the middle nuts on the top side of the bottom cover, after first inserting a thin steel plate of $^1/_{10}$ mm. in thickness below the nuts. Then, after the upper halves of the stay blots are screwed into position the top cover nuts are tightened, so that the middle nuts are lifted, and the thin packing plate withdrawn. This method provides a simple adjustment, and the liner is so held that any expansion is taken up by the elasticity of the engine parts without giving rise to undue stresses.

The general construction of the other parts of the engine are similar to those of the single-acting engine. Both the top and bottom cylinder covers are square, and are bolted together in groups of three and four for the six and eight-cylinder engines respectively. The columns are connected horizontally by means of distance pieces at the top of the crank case. At this part of the engine an oil scraper in the form of a stuffing-box is fitted, which prevents oil from the crank case being carried up on to the piston-rod. Drawing, Fig 3, shows the general construction of the connecting-rod, crosshead and piston. The connecting-rod top end is of the forked type, with guide shoes which work on loose guide plates bolted to the columns between the cylinders. Forced lubrication is used for these plates, but they are not water cooled. A steel piston-rod is employed, with a flanged top, to which the two halves of the piston are secured. The piston has eight piston rings. To the bottom half of the piston a cast iron sleeve or liner is bolted, which encircles the piston-rod and passes through the bottom stuffing-box. This liner forms an annular cooling chamber around the rod, through which oil is circulated under pressure, and so reaches the piston head, from which it is returned through a central passage in the piston-rod to a visible outlet on the column, whence it passes to the bottom of the crank case. The piston-rod stuffing-box is separately water cooled, and is furnished with ten self-expanding cast iron rings. Some idea of the size of the 29½in. throw crank shaft can be obtained from the photograph reproduced in Fig. 4. The balance weights, it will be seen, are fitted on the two inner cranks only. The valve gear is arranged midway between the top and bottom covers and cams are provided for both the bottom and top valves, two reversing shafts being fitted, which, during manœuvring operations, bring the rollers into contact with the cams. Bearings are so arranged that one cylinder casing complete with its covers can be removed without dismantling the cam shaft. At the centre of the engine is the cam shaft drive, and two driving chains in an enclosed casing are fitted. This part of the engine is quite free to work with the ship. Illustration, Fig. 5, will serve to indicate the centrally arranged fuel pump and control gear. The engine is provided with a starting valve on both cylinder covers; it may be stopped, reversed and started quite as efficiently as the single-acting engine. The engine works on the full Diesel cycle, with a compression pressure of 32 atmospheres, or about 470 lb., on both the top and bottom sides of the piston. As regards the work of the pistons, piston rings and liners, the double-acting principle imposes no new conditions. The combustion stroke on the top side of the piston coincides with the compression stroke for the bottom side, and when ignition is taking place in the bottom combustion space, the exhaust gases are being expelled from the top space. Similarly, the inlet stroke for the bottom space coincides with the exhaust stroke for the top. Thus, the piston rings are released from pressure at every second revolution, and good lubrication is always ensured. Further, the wear on the cylinder liner is distributed over both ends of the liner, which is a good feature of the design.

The first large engine of this type constructed by Burmeister and Wain is shown in Fig. 5. It is a six-cylinder unit, with cylinders 840 mm., of 33$^1/_{16}$in. diameter, and a stroke of 1500 mm., or 59$^1/_{16}$in., designed to develop 6750 shaft horse-power at a speed of 125 revolutions per minute. Two such engines are to be shortly installed in the Swedish-American liner Gripsholm, the hull of which vessel was launched by Sir W. G. Armstrong, Whitworth and Co., Limited, at Newcastle last year. The designed speed of the liner is 17½ knots, and the Gripsholm will be the first vessel to be propelled by double-acting engines of the four-stroke type. The compressed air required for running and manœuvring will be obtained from three 800 indicated horse-power Diesel-driven air compressing sets, two of which will be run at sea, the third acting as reserve set. Three 330-kilowatt oil engine driven generators will supply the current for operating the auxiliary machinery.

The first main engine of the Gripsholm has undergone successful shop trials in Copenhagen and the following results were obtained during a forty-eight hours' test:—

Brake horse-power	6858 B.H.P.
Indicated horse-power	8653 I.H.P.
Speed of engine	126.6 revs. per min.
Mechanical efficiency	79.24 per cent.
Average fuel oil consumed per hour	1189 kilos.
Average fuel consumption per I.H.P. hour	137.3 grammes, or 0.302 lb.
Average fuel consumption per B.H.P. hour	173.3 grammes, or 0.381 lb.

Harland and Wolff, Limited—Messrs. Burmeister and Wain's licensees in Great Britain—have three twin-screw installations on order with eight-cylinder engines, and two twin-screw sets of smaller output with six-cylinder engines, besides other orders pending. Another licensee, the Stabilimento Tecnico Triestino is constructing two twin-screw installations of eight-cylinder engines for the Consulich Line, Trieste, from which it will be seen that within a short time eight passenger liners will be fitted with sixteen of these double-acting four-stroke engines. From the table of standard sizes of engines given immediately below, it may be noted that engines up to 33,000 shaft horse-power are contemplated, with cylinder bores up to 1100 mm., or 43$^1/_{16}$in. With engines of such power available considerable development of the motor vessel should take place in the near future.

ENGINE DIMENSIONS AND WEIGHTS.

TWIN SCREW.

Trunk Type.

S.H.P.	No. of cyls. each engine.	Bore stroke, mm.	Revs. per min.	Weight of two engines in tons.	Weight per 100 S.H.P. in tons.
2,000	6	500/900	165	170	8.5
2,500	6	550/1,000	150	220	8.8

Crosshead Type.

3,000	6	630/1,100	130	340	11.3
4,500	6	740/1,300	120	540	12.0
6,000	8	740/1,300	120	680	11.3

Double Acting: Crosshead Type.

9,000	6	680/1,400	130	620	6.9
13,500	6	840/1,500	125	1,050	7.8
25,000	6	1,100/1,800	105	2,060	8.2
33,000	8	1,100/1,800	105	2,640	8.0

SINGLE SCREW.

Crosshead Type.

S.H.P.	No. of cyls. each engine.	Bore stroke mm.	Revs. per min.	Weight of engine in tons.	Weight per 100 S.H.P. in tons.
1,100	6	500/1,250	130	115	10.5
1,350	6	550/1,350	120	150	11.1
1,900	6	630/1,550	115	220	11.5
2,400	6	740/1,800	110	285	11.6
3,100	8	740/1,500	105	355	11.5

Double Acting: Crosshead Type.

4,000	6	680/1,300	105	350	8.75
6,000	6	840/1,700	105	590	9.85

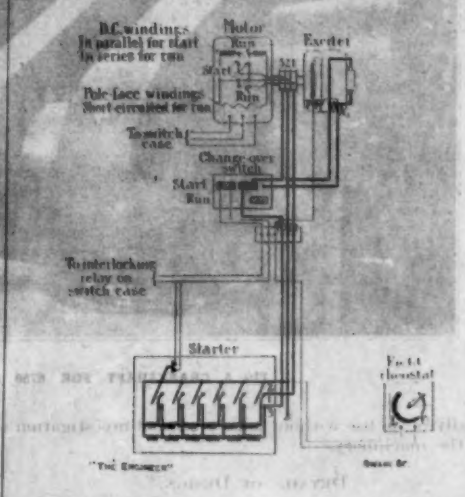
Synchronous Motors for Mining Work.

In Major E. Ivor David's paper on "Electricity in Mines," read before the Institution of Electrical Engineers on Thursday, February 19th, some useful information is given relative to the use of modern salient pole and cylindrical rotor synchronous motors. One of the main advantages of th se motors is, of course, that they can be employed for power factor correction, and they can be started with practically the same ease as ordinary induction motors. It is explained that as it is usual in this country to start mining ventilating under load, the synchronising torque is high, and cylindrical rotor type motors are therefore used. Experiments have, however, been carried out in the United States with salient pole motors, working with a friction clutch, and the starting effort has also been reduced by closing the fan discharge.

On account of the moderate speed of mine-ventilating fans it is usual to drive through some form of reduction gear. In the early stages of the development of a mine the quantity of ventilating air is low, but as the roads are lengthened and the workings extend, the requirements, both as regards volume and pressure, become greater. Progressive increases in the speed can be arranged for when gear drives are used by changing the gear wheels, but recently the author has introduced the old jockey pulley drive, with modern improvements, and this has proved a very efficient and flexible method of reducing the speed, whilst to change the fan speed it is only necessary to change the motor pulley. On account of the flat efficiency curve of the synchronous motor at unity power factor, the light load efficiency is high. The starting up of a 450-kilovolt-ampère synchronous induction type fan motor on light load—i.e., about 90 kilowatts—and excited for a power factor of about .5 leading, improved the power factor of a colliery system from .7 to .87 or .9, and the voltage at the bus-bars increased from 3050 to 3150, with both the alternating-current winders off.

An interesting type of synchronous motor for fan drives has a salient pole rotor with extended pole tips, having a single-phase winding in semi-enclosed slots. For starting purposes the pole windings are split in halves, and are connected as a second phase, a metallic resistance being placed in series with the two windings. The motor has a torque characteristic similar to that of an ordinary slip-ring machine, and when it has been brought up to speed the pole face winding is short-circuited. The connections for the motor are shown in the accompanying diagram, and it will be perceived that when the motor is at work the pole face winding acts as an amortisseur, whilst the salient pole winding is excited in the usual way.

Prior to 1918 it was thought that high-speed vertical two-stage compressors could not be driven by salient pole motors without the use of a friction clutch. But as the result of a series of starting experiments carried out with a



large direct-current motor-driven compressor of the horizontal cross-compound type, and also with an induction motor-driven high-speed vertical type compressor, both fitted with unloading devices on the high and low-pressure cylinders, it was found that the torque required to start these machines was only about 25 to 30 per cent. of the full load torque.

In the meantime a salient pole synchronous motor had been installed in a Lancashire colliery to drive a Belliss vertical compressor through a friction clutch, but it was soon found that the clutch was unnecessary, and two salient pole motors of 1125 horse-power and designed for a speed of 214 revolutions per minute were subsequently installed for driving a two-stage compressor, having an output of 6500 cubic feet of air per minute, compressed to 75 lb. per square inch.

On account of the large air gap that is permissible in this type of motor, it was found possible to dispense with the bearing between the compressor fly-wheel and the rotor, thus reducing the length of the set by 4ft., compared with a synchroncus induction set of similar horse-power. The efficiency of these motors at full load and unity power factor is 95.7, a remarkable figure, the author states, for motors of this size and speed.

Books of Reference.

The Directory of Shipowners, Shipbuilders and Marine Engineers, 1925. The Directory Publishing Company, Limited, 33, Tothill-street, S.W. 1. Price 20s. net.—This year marks the twenty-third year of issue of this useful volume. It is handy for the desk, and although it contains some 25,000 references to shipping and shipbuilding firms throughout the world, it is yet quite convenient for travelling use. Particulars are given concerning the most recent German shipping developments. The Hamburg-Amerika Line has now 55 ships, and operates more than a dozen services, while the Hamburg-South American Line has now 19 vessels, and the Norddeutscher Lloyd 44 vessels. The main sections of the directory furnish particulars regarding the British Admiralty and other Government departments, the Classification Societies, also the leading steamship companies, shipbuilders, ship repairers and marine engineering works throughout the world, with details of the fleets owned and the names of the directors and the principal officials. A supplementary section includes information relative to societies, institutions, trade and labour organisations, and a directory of consulting marine engineers and naval architects. The directory is complete with a well arranged index.

The South American Hand-book, 1925, which is published by South American Publications, Limited, Atlantic House, Moorgate, London, E.C. 2, price 7s. 6d. net, claims to be a guide to the countries and resources of Latin-America, inclusive of South and Central America, Mexico and Cuba. It appears again this year in the new form which was given to it last year, and the reception given to that edition has encouraged its publishers to promote the all-round character of the book so as to render it "more serviceable to the traveller, actual or potential, commercial or uncommercial; to the prospective settler seeking a

new career; to the investor desiring information about the resources of the new countries in which he is invited to venture capital; and to the stay-at-home business man in need of enlightenment that is not immediately procurable from other sources. They have certainly managed to produce a most readable volume which is teeming with information of most varied kinds, much of which should be useful to engineers having business connection with the different countries of Latin-America.

The "Motor Ship" Reference Book for 1925. The Temple Press, Limited, London. Price 5s.—The staff of our contemporary journal, *The Motor Ship*, has compiled a very handy reference book in which will be found information on all matters relating to the motor ship and its machinery. A notable feature is the concise description of the many different types of marine oil engine in service, which is illustrated by well chosen drawings and photographs. A list of the world's motor ships and of marine oil engine builders is given, as well as information relating to fuelling and operation of motor vessels.

The "Practical Engineer" Mechanical Pocket-book and Diary, 1925, which is obtainable from Humphrey Milford, Amen Corner, London, E.C. 4, price 3s. 6d., is now in its thirty-seventh edition. It contains an entirely new section—No. XVII.—which is devoted to Cranes and Lifting Tackle. This new section is excellently illustrated, and we understand that much of the subject matter which it contains has been specially written. The notes on Workshop Design and Patent Law have been entirely re-written, and in others there has been a good deal of amendment so as to bring them fully up to date. We notice, also, that there has been a good deal of regrouping of various notes with the object of facilitating reference,—an object which appears to have been achieved.

Ice and Cold Storage Trades Directory, 1925, which is published by Iliffe and Sons, Limited, Dorset House, Tudor-street, London, E.C. 4, price 10s. 6d., runs this year—its eighteenth issue—to some 250 pages. It is too well known now to need detailed description, and all that need be said of the present edition is that it has evidently been carefully revised and brought up to date and that several new headings appear in the Classified Trades Section. As usual there are given lists of the companies registered, and of the patents relating to refrigeration and cognate matters which have been granted since the last issue of the Directory.

Road Tests of a Diesel-Electric Locomotive.

In our issue of November 14th, 1924, we described in detail the design of the Diesel-electric locomotive built for the Russian Government Railways by Professor G. Lomonossoff, in collaboration with the Hohenzollern Locomotive Works in Düsseldorf, and gave also the results of the concluding trials made on the testing plant which had been specially built for this purpose. We have now received information which we think will be of interest to our readers concerning the working of the engine when hauling test trains.

After completion of the trials on the testing plant, the engine was taken into the paint shop and then prepared for forwarding to its destination. For this purpose it was lifted and placed on wheel sets of the standard 4ft. 8½in. gauge, in order to allow it to be transported to Dunaburg, in Latvia, where it was again fitted for the Russian gauge of 5ft.

Here a number of preliminary trials took place before the engine was allowed to leave for Moscow, which is nearly 700 miles distant, thus ensuring as far as possible that everything was in order. These runs took place between Dunaburg, Rjeshiza, Kreuzburg, and Dunaburg, the round trip being about 156 miles, while the weight of the trains hauled varied between 550 and 1200 tons. On one of these trips the Latvian Minister of Railways, with a number of leading engineers of that country, were present, and they all expressed themselves as exceedingly gratified with the impressions they had received as to the capabilities of the locomotive and the possibilities it opens up for the future.

The Russian dynamometer car was in all cases attached to the engine, so that it was possible at any time to make observations. These observations confirmed the accuracy of the results obtained on the testing plant, an overall thermal efficiency as high as 27 to 28 per cent. being reached. We believe it is intended to make more exhaustive investigations in this respect later on, when the drivers have become accustomed to handling the engine, and it is put to the regular every-day work for which it is intended.

These preliminary trials having been passed satisfactorily, the engine left Dunaburg on Monday, January 19th, for the Russian frontier station, Sebesh, distant about 100 miles, where a commission appointed by the Soviet Government awaited its arrival in order to examine it thoroughly and report as to whether it conformed to the conditions imposed by contract on the builders. The chairman of this Commission was Professor M. Prawosodowitsch; on behalf of the builders, the Hohenzollern Locomotive Works, Messrs. King and Schwerz were present; while the builders of the Diesel motor, the M.A.N. Company, of Augsburg, were represented by Mr. B. Wedemeyer. In addition, the trials were watched by Professor Nordmann and Mr. Laschke, on behalf of the German State Railways.

The Customs and other frontier formalities having been duly completed, the engine left Sebesh early in the afternoon of January 20th, hauling a train of 149 axles, with a total weight of 908 tons, for Welikije-Luki, distant 87 miles, where the train remained for the night. The next day the journey was continued as far as Rshew, a distance of 151 miles, starting with a gross load of 876 tons (148 axles), which, however, was reduced to 854 tons in Sapadnaja Dwina, and further to 532 tons, or 60 axles, in Nelidowo, as certain wagons had already reached their destinations. The average speed on this section was 19 miles per hour, with gradients as steep as 1 in 125.

On Thursday, January 22nd, a train of 1000 tons was hauled 142 miles from Rshew to Podmoskownaja, but as orders had been issued that the engine and train must enter the Brest Station at Moscow at noon on the following day, in order to be officially welcomed by the representatives of the Government, the night was passed in the before named suburban station. The reception was the occasion of an enthusiastic demonstration and much speech making, the interest excited being so general that it was proposed to allow the locomotive to remain in Moscow two days, so that it could be inspected. This plan, however, was not carried out, as it was suddenly decided to send it on the night on January 24th with a light passenger train of 325 tons to Briansk, a town 237 miles distant, on the Moscow–Kiew line, it returning the following night with a slightly heavier train, in which the Minister for Ways and Communications was travelling.

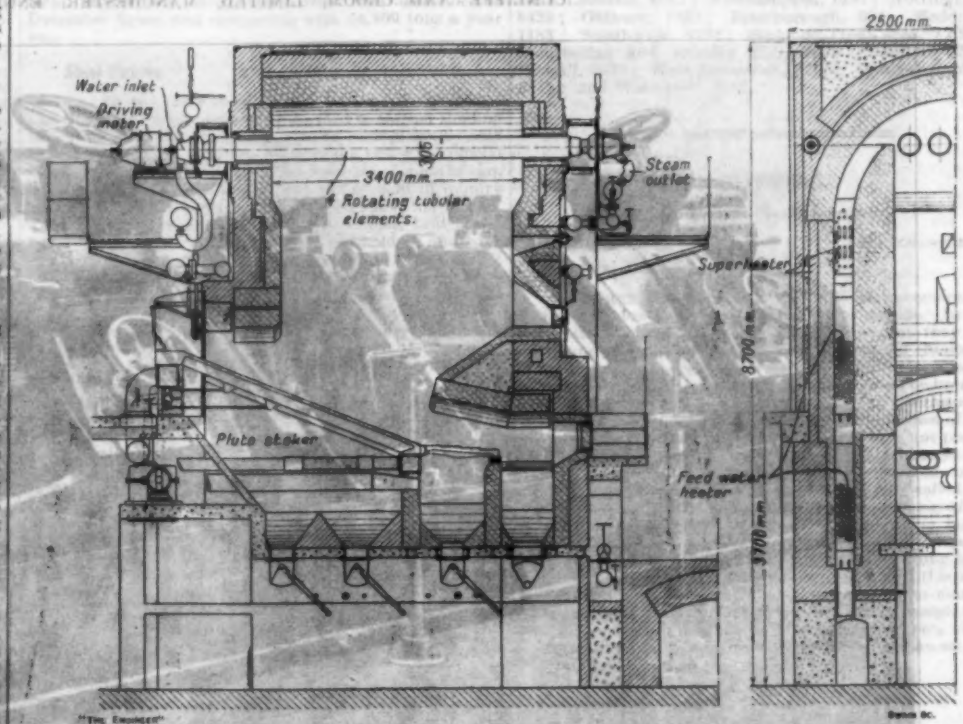
The following days were occupied in making short runs to Krjukowo and Klin, 24 and 56 miles respectively. In one of these trips the leading members of the Ministry of Ways took part, while on another occasion the members of the Government were present, and the engine hauled a train of 1797 tons up a long gradient of 1 in 333 at a speed of 15¼ miles per hour. A stop was purposely made on this gradient in order to prove the starting qualities of the engine, the Diesel motor being also stopped. After standing for about 3 min. the Diesel motor was started, and the train was without difficulty set in motion. The tractive effort registered by the dynamometer was 22 tons, and although this figure means a coefficient of friction of about 0.23, yet there was no sign of any inclination of the driving wheels to slip.

On the last trial carried out on Monday, February 2nd, with a total load of 1950 tons, a speed of 15.1 kiloms. was attained on 1 in 200 up, the length of the gradient being 4.7 miles. On this incline, with the load named, the contract only required a speed of 12 kiloms. The consumption of oil, or masout, was found to be 0.226 kilos. per horse-power per hour, measured at the circumference of the tires, the contract allowing 0.4 kilos. The actual consumption was consequently only 0.565 of the quantity allowed, or, if corrected for the higher speed, it works out at 0.181 kilos., or 0.45 of the consumption permitted by the contract.

An examination of the Diesel motor took place at the end of the trials, and showed that it was in perfectly good condition. The results of the trials taken altogether were so satisfactory that the Commission on February 3rd signed the protocol accepting the engine on the part of the authorities, it having then run 3000 kiloms., although the contract stipulated 5000 kiloms.

Looking at these figures, it must be admitted that Professor Lomonossoff is to be congratulated on the decided success he has obtained in solving a technically difficult problem. It is now a question for the designers to reduce weight as far as possible, at the same time lessen the cost of building to a reasonable limit, although the Diesel locomotive probably will always be more expensive than its steam competitor, which, at least in this respect, will be hard to beat. But, if we consider the results already obtained on the testing plant, and on the journey between Sebesh and Moscow—where only about one-quarter of the quantity of oil was consumed which is allowed for steam locomotives doing the same duty, we can easily understand the importance attached in Russia to the appearance of the first Diesel locomotive doing heavy main-line work reliably and with ease. The engine was driven during all the tests by Messrs. Terpigoff and Dmochowski, who relieved each other at the controller, an arduous and tiring task, as naturally the Russian drivers had still to be trained to handle the engine.

THE ATMOS HIGH-PRESSURE BOILER



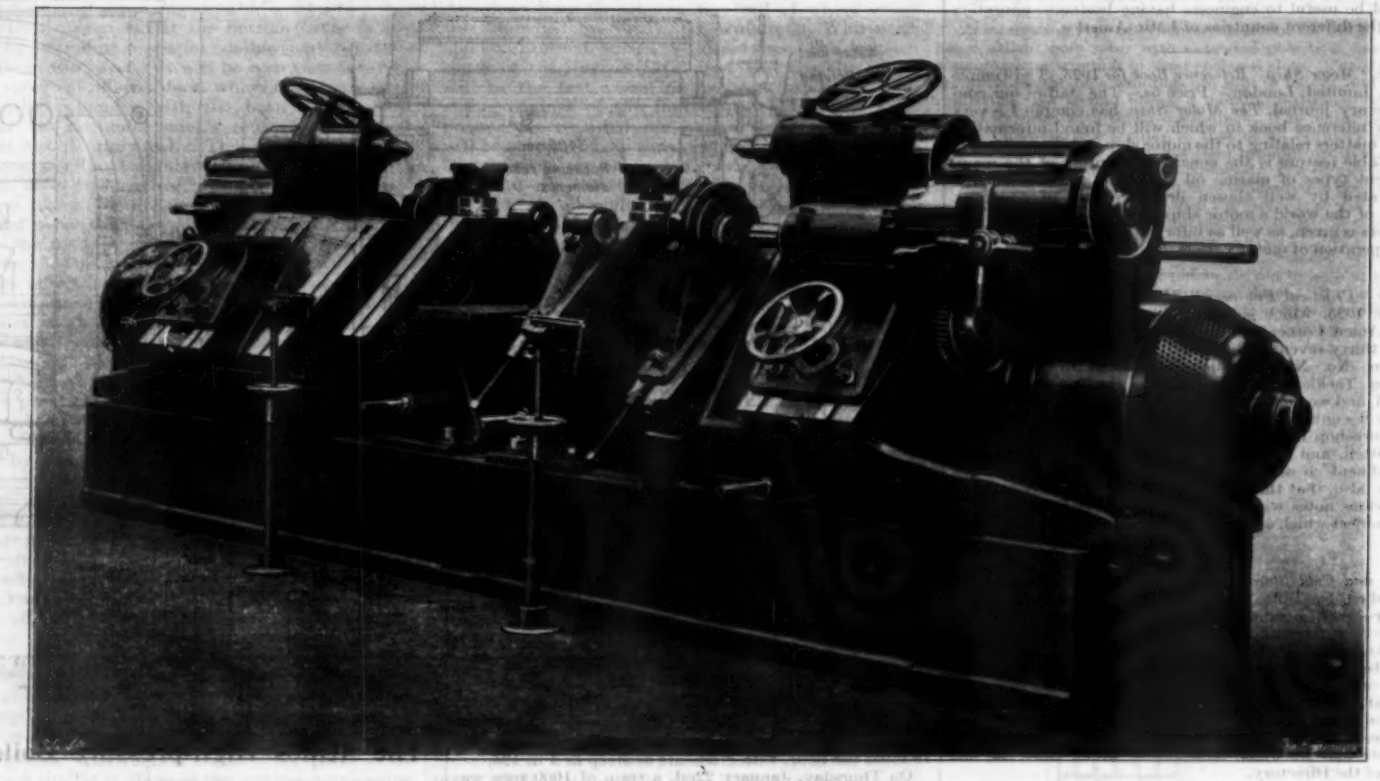
The Atmos High-pressure Boiler.

In the Atmos high-pressure boiler, invented by the Swedish engineer, Mr. J. V. Blomquist, use is made of a rotating tube element, which is surrounded by the furnace gases. The tube is supported in special stuffing-boxes, similar to those used on the high-pressure end of the Brünner steam turbine, and is driven at a speed of about 300 revolutions per minute by a direct-coupled electric motor. Feed water at a high temperature is introduced through the forward stuffing-box, and forms a thin skin of water on the walls of the rotating tube, from the surface of which steam is rapidly generated, and taken off from the other end of the tube. An experimental single-tube boiler was built in 1915, and in 1921 the first large unit, a six-element boiler designed for a working pressure of 60 atmospheres, say, 880 lb. per square inch, and an output of 3000 kilos. of steam per hour, was built. It was supplied to the Svenska Socker-Fabriks Actiebolaget, of Gothenburg, and two years later a second boiler was built for the same factory. It had four tube elements, and was designed for a working pressure of 100 atmospheres, or about 1470 lb. and for an output of 4000 kilos. of steam per hour at a temperature of 400 deg. Cent. In June last this boiler was tested by Professor E. Josse, of Charlottenburg, and Professor Lindmark, of Stockholm. A description of this test was given in the *V.D.I. Journal* for February 14th of this year, from which we take the illustration herewith reproduced and a brief summary of the chief features of the boiler and the results obtained. The heating surface of the four tube elements is 13 square metres, and the boiler, which is fitted with a Pluto stoker, has a grate area of 7.4 square metres. The rotating tubes are made of rolled mild steel, 19 mm. in thickness. At each side of the boiler are superheaters and feed-water heaters, arranged in parallel, and the hot gases pass through these tubes after leaving the main combustion space. The superheater has a total surface of 8.45 square metres, and gave 91 deg. Cent. superheat. The feed-water heating tubes have a surface of 191 square metres, and the feed water was raised to 158 deg. Cent. About 12 per cent. of the total steam was raised in the feed-water heaters, and passed through a steam separator to the main steam space. The feed-heater tubes were fed by an electrically driven pump with four pistons, and the electrical energy absorbed by the motors driving the rotating tubes was 3.3 kilowatts. At the high steam pressure of 1470 lb. per square inch there was no difficulty experienced with the stuffing-boxes at the ends of the tubes. During the trial Cowdenbeath coal, with a lower heating value of 6100 calories per kilogramme, or, say, 11,000 B.Th.U. per lb., was used, and a moderate boiler efficiency of 73.2 per cent. was obtained. From the output of the boiler it was calculated that the amount of heat absorbed per square metre of the rotating elements was 94,200 kilogramme-calories per hour, about two-thirds of this being radiant heat and one-third heat of convection. The rotation of the tubes would appear to assist the amount of heat transmitted by convection, and it is of interest to note that in the new design of boiler ribbed tubes are to be employed. The combustion temperature can be raised by the use of pulverised fuel, but these and other technical developments may be carried out without difficulty. The trials appear to show that the Atmos high-pressure boiler is a practical article, and that it marks a step in the direction of the use of steam at high pressures.

LANTERN SLIDES.—Stothert and Pitt, Limited, of Bath, ask us to announce that they have a set of over sixty lantern slides illustrating various types of electric and steam cranes, grabs, winches, mixers, pumps and conveyors, which they are ready to lend for lecture purposes.

LOCOMOTIVE WHEEL QUARTERING MACHINE FOR EAST AFRICA

CUNLIFFE AND CROOM, LIMITED, MANCHESTER, ENGINEERS



Locomotive Wheel Quartering Machine.

THE engravings on this page represent a self-contained motor-driven machine which we recently had an opportunity of inspecting at the works of the builders, Cunliffe and Croom, Limited, Broughton Ironworks, Manchester. It has been designed for drilling and boring the crank pin holes in locomotive wheels, at quarter centres and also for turning new or worn pins in position on wheels with either the right or left-hand crank leading. Each end of the machine is driven by means of a 5 horse-power variable-speed electric motor provided with pillar type controllers for speed variation. The drive from the motors to the spindles is through spur gearing and the adjustment of the gear for varying throws and changing from right to left-hand lead are carried out by means of a swinging frame. The two headstocks are fitted with 4in. steel spindles controlled by hand wheels and rack and pinion motions. The sliding faces which carry the boring saddles are disposed at an angle of 90 deg. to each other. Each headstock is adjustable along the bed for varying lengths between the machine centres up to a maximum of 8ft. 6in. by means of a screw and ratchet motion. Adjustable saddles on the two faces of each main headstock are fitted to receive the boring headstocks. These boring headstocks are adjustable along the inclined faces to suit the varying lengths of throw. They have spindles 3in. diameter, bored to No. 5 Morse taper, and have two rates of feed giving thirty and sixty cuts per inch. The speeds of the spindles range from 12 to 24 revolutions per minute and the hand adjustment is controlled by handles conveniently placed. Supporting stays are fitted to the main headstocks and are provided with bushes to carry the boring bars or turning blocks, as required.

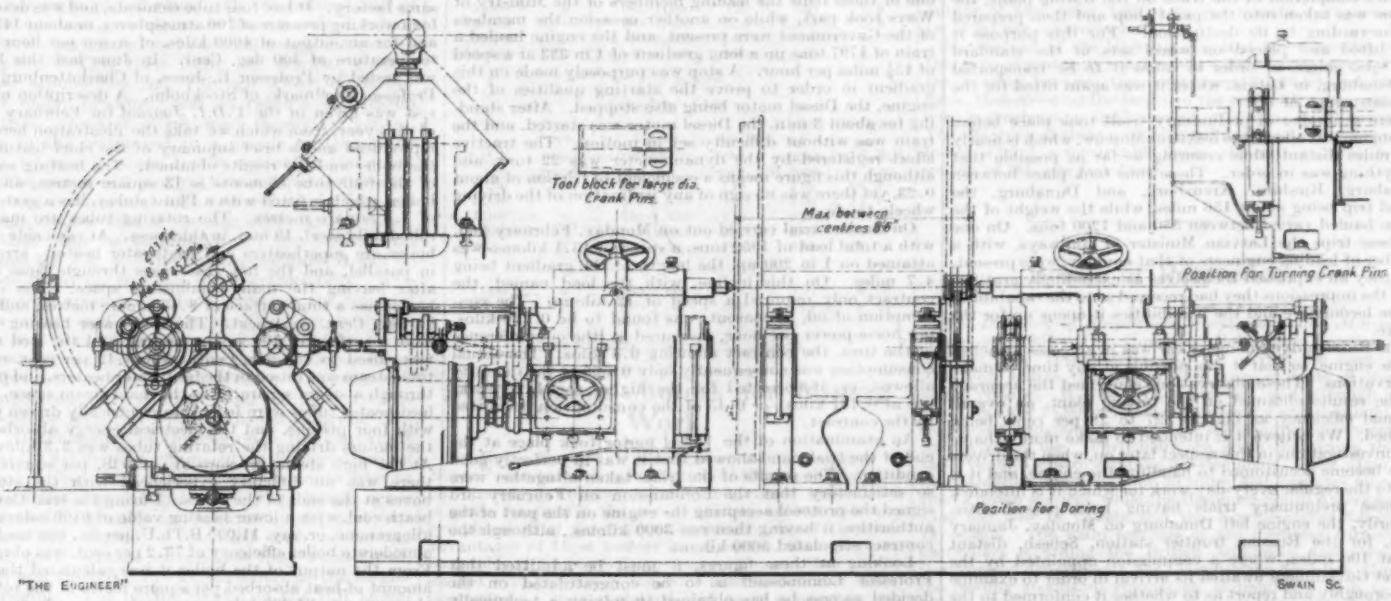
Mounted on the bed are two substantial stays which are provided with elevating V blocks to support the wheels on their journals. These blocks are adjustable laterally to give true location to the work. Each stay carries a platform facing immediately beneath the crank journal for the purpose of enabling a height gauge or indicator to be used under the journals when quartering wheels with inside cranks. The stays are movable along the bed by ratchet, rack and pinion gearing, and their outer faces are machined and provided with T slots for securing the wheels after location.

All the angular sliding faces on the headstocks are fitted with hardened steel rules and pointers for setting to the required throws of the crank pins, and the equipment supplied with the machine includes two adjustable screw jacks for "inching" the work round.

The following are the leading dimensions and weights of the machine :—

Maximum diameter of wheels admitted	72in.
Gauge of wheels, up to	4ft. 8½in.
Maximum distance between centres	8ft. 6in.
Crank throws, between	8in. and 18in.
Maximum diameter of crank pins admitted	8in.
Maximum length of crank pins admitted	14½in.
Approximate net weight	10½ tons

The machine was built by Cunliffe and Croom, Limited, to the order of Alfred Herbert, Limited, for use in the Lourenço Marques shops of the Mozambique Railway in Portuguese East Africa.



ARRANGEMENT OF LOCOMOTIVE WHEEL QUARTERING MACHINE

South African Engineering Notes.

Pig Iron from Union Ore.

According to the latest information the plant required for the starting up of the Newcastle Ironworks, now absorbed by the Union Steel Corporation, is to be shipped immediately. Within a few months, therefore, pig iron from South African ore will be produced. Last year's production at the steel works at Vereeniging, belonging to the Corporation, was a record one, but the necessity for increased production to meet continental competition is urgent. Arrangements have been concluded for providing the required additional capital to cover the absorption of the Newcastle works and the extension of the steel works at Vereeniging. The absorption of the Newcastle concern will enable the Corporation to obtain an output of iron and steel produced from native ores, which will bring it within the scope of the Iron and Steel Industries Encouragement Act, and so enable it to secure the 15s. per ton payable thereunder.

Union Air Mail Service.

For the purpose of enabling the coastal towns of the Union of South Africa further east than Cape Town to reply to their overseas mail by the next returning mail steamer, instead of, as at present, losing a week, the Union Government is proposing to institute an air mail service which will commence on March 2nd, and will convey the mails from the mail steamer, immediately on her arrival

at Cape Town, to the coastal towns of Mossel Bay, Port Elizabeth, East London and Durban. The total time for the single journey from Cape Town to Durban will be 10 hours 35 minutes, and the saving in time on the journey to and from will be 40 hours, as compared with pre-existing means of transport. Even the nearest coastal town, Mossel Bay, will benefit to the extent of 48 hours on the double journey. Each machine will be able to carry 400 lb. of mail matter. In addition to the ordinary postage there will be a surcharge on mail matter conveyed by air mail, which, in the case of overseas letters, will amount to 6d. per ounce. The benefits to business men will be so great that there is no doubt that there will be ample support to make the service a success. The British postal authorities are assisting by placing the mail for these towns in a special bag which, immediately on the arrival of the mail boat at Cape Town, will be taken by fast motor van to the waiting aeroplane.

Mineral Production of the Union.

The total mineral production of the Union of South Africa for 1924 is valued at £53,958,306, taking gold at standard value. The premium, however, adds £3,827,918, bringing the total value of the Union's gold production to £44,500,365, and the value of the total mineral production for the year to £57,786,224. During 1923 the premium added £2,712,151 to the value of the gold produced. The figures for 1923 and 1924, with gold in each case taken at standard value—the premium not added—are as follows :—

	1923. £	1924. £
Gold	38,862,794	40,672,447
Silver	197,888	212,602
Osmiridium	43,528	102,886
Diamonds	6,038,207	8,029,456
Coal (sales)	3,713,706	3,830,163
Copper Ore and Concentrates	404,511	511,844
Tin concentrates and metallic	170,337	304,108
Other minerals	295,704	294,790
Total value	£49,548,675	£53,958,306

The "other minerals" include lead to the total value last year of £140,200 and asbestos £110,075, as compared with £133,573 and £121,453 respectively for the previous year. Sales of corundum last year amounted to only £13,284, as compared with £22,543 in 1923.

The coal output, totalling in the twelve months 12,490,493 tons, was the highest recorded since the commencement of the Union, the previous year's 11,917,036 tons being, until then, the record. In price, however, 1921 holds the record, with £5,072,401 for the 11,396,905 tons then produced.

The quantity of gold produced in 1924, 9,597,634 fine ounces is another record, the next best year was 1916, when the output amounted to 9,296,618 oz. Last year's declared estimated working profit was £14,650,836, which is nearly £2,000,000 higher than in the previous year. Working costs were brought down to an average of 19s. 9d. per ton for the whole of the Transvaal mines, and 19s. 7d. for the Witwatersrand mines, as compared with 20s. 2d. and 20s. respectively in 1923.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Further Shading of Prices.

THE continued abstention from buying is causing many Midland producers of iron and steel considerable anxiety as to the disposal of their output, and this week there has been a further shading of prices by manufacturers anxious to avoid increasing stocks. Iron and steel makers find it increasingly difficult to maintain their cheerfulness. Business is of small dimensions, and for current needs only. There are no reserves of orders, but the fact that so many of the Midland works are continuing in fairly regular operation indicates that current needs, on the whole, are fairly substantial. The proportion of South Staffordshire plants that are standing idle this week, or are making only a curtailed output, is as great as hitherto.

Staffordshire Bar Iron.

Business in finished iron shows a slight improvement. There is a fair amount of activity in the marked bar branch, and no difficulty is experienced in obtaining the basis rate of £15. In other branches material is very slow of sale, and though there are no formal revisions of prices, business can only be done on a competitive footing by recognising the deteriorating effect of the depression since Christmas. Crown quality bars are quoted at £12 15s., but sales are reported to have taken place at below that figure. Nut and bolt iron is quoted at £11 15s., but here, again, shading is prevalent. Some of the Darlaston manufacturers are doing a little better, but the business is unevenly distributed. No. 3 Belgian iron for nut and bolt making is quoted £7 15s. delivered in the Black Country. The further subsidence of the franc is not reflected as yet in the general run of continental quotations. Some products, among them iron bars, have been offered at somewhat lower rates this week. The nut and bolt trade, however, is not taking very large quantities, either of English or foreign bars at present. South Staffordshire has benefited from the cheap steel imported, enabling the local mills to produce re-rolled steel in fairly good quantities on competitive terms. Wrought iron gas tube strip is quoted £13 to £13 2s. 6d.

Sheets.

Galvanised corrugated sheets of 24 gauge continue in good request at from £17 to £17 5s. per ton f.o.b., and the improvement in deliveries is maintained. Good quantities of black sheets are being called for for the motor and cycle trades, and various stamping requirements. It is noted that the improvement in exports continues. Sheet manufacturers had the briskest export trade in January they have experienced for some months, the total, 56,903 tons, being nearly 6000 tons ahead of the December figure, and comparing with 54,809 tons a year ago.

Steel Values.

In the steel department, business is irregular, and the keenness of competition has led to further shading of prices. Sections are stated to have been generally sold this week at £8 15s., which is 10s. per ton below the official standard, and the price prevailing a couple of months ago. Specifications continue scarce, but the amount of inquiry in the hands of engineers continues rather above the normal. The foreign enterprises in view include pier, bridge and jetty construction, with some large gas-holders and pipe lines called for by various foreign countries. This district, unfortunately, is not well placed for dealing with foreign construction, owing to the keen competition in the North, where steel works allied with constructors supply the steel at much more favourable prices than are quoted to Midland engineers. Small bars are obtainable at £9 ; ship, bridge and tank plates at £9 15s.; and boiler plates at £13 10s.; Staffordshire hoops are £11 10s. at works ; mild steel billets are on offer at from £7 to £7 5s. Competition from the Continent is not so acute as it has been, though substantial deliveries on contracts made some time ago are being made. Foreign joists can be bought delivered here at £6 17s. 6d., and a lot of this steel is being used for constructional work. Foreign billets are offered at £6 7s. 6d.

Steel Scrap.

Steel scrap sells very slowly. Requirements are normally large, and users would place contracts if they could buy at their own price, but merchants prefer to hold the material for better selling rates.

Pig Iron.

Pig iron business in the Midlands shows no improvement, and prices are "cut." There is very little forward business, most buyers limiting their purchases to immediate requirements. Orders seldom exceed 50-ton lots. Quotations are about where they were. Some furnacemen are impatient to get openings for their unsold output, even if they have to make further concessions to do so. These breaches in the general level of values have a weakening effect. Smelters have already given away their profit margin in many instances, and those who are free to adopt an independent attitude are not disposed to countenance further depreciation. Foundry pig remains in better request than forge. There is not much activity in basic. East Coast hematite is offered at something above £5 delivered in this district, but there are no buyers. Northamptonshire forge is quoted £3 10s., and No. 3 foundry at £3 15s., while Derbyshire forge commands £3 16s., and foundry £4 to £4 1s.

Blast-furnace Coke.

Coke prices are maintained on the whole. It is possible to buy at fixed prices which work out at about 1s. below the scale, for which the cokeries fought at the turn of the year. The relapse is, however, traceable to the anxiety of a few Yorkshire collieries to disburden themselves of stocks.

Foreign Competition.

The keenness of foreign competition and the formidable nature of continental rates of exchange are shown by the imports into this country in January of 18,524 tons of basic pig iron, against 6568 tons the same month last year, 55,124 tons of steel billets, about the same as in the previous January, 29,985 tons of iron bars, &c., and 34,165 tons of steel bars. The most disquieting feature is the large import of finished bars, angles, &c., to the extent of about twice the quantity of a year ago. Plates and sheets totalled 16,312 tons, against 7409 tons for the corresponding month of last year. It is interesting to note that of the 18,524 tons of basic pig imported, 15,733 tons were received from France, as compared with a tonnage of 3325 tons from the same source in the previous January. Belgium sent over 4000 tons of forge and foundry pig, and the total imports of pig iron were 26,178 tons, against 12,652 tons in the corresponding month of last year. Iron and steel exports in January totalled 337,475 tons, compared with 307,808 tons in December. Foundry pig iron exports show a little recovery, but most descriptions of finished material compare unfavourably with a year ago.

Coventry Engineering.

Business in the Coventry motor engineering establishments is very brisk, and trade as a whole gives cause for considerable satisfaction. Coventry must be regarded as a favoured spot, compared with other industrial centres, though it has to be remembered that the present is the season of the year when the hay has to be made. The overseas trade has been an important feature for some time past, and the efforts put forward by the car manufacturers to regain the overseas markets continue to meet with a gradually increasing response. The Engineering Employers' Federation's proposal in regard to the wages question has been put forward, and Coventry, with much at stake, can only await the result of the consideration of the suggestion by the executives of the engineering unions. Manufacturers are fully satisfied that under present conditions the industry cannot bear any addition to the load of production costs.

Unemployment.

To the satisfaction of all concerned, the unemployment figures in the Midlands area continue to fall. The latest returns show 3448 fewer workless than a week ago, the Ministry of Labour's register showing the total to be 140,497, which is no less than 14,000 fewer than a month ago. Of the total, 96,825 are men, 1973 boys, 38,051 women, and 3648 girls. The returns for the principal towns in the area are :—Birmingham, 28,828 ; Bilston, 2792 ; Coventry, 1400 ; Cradley Heath, 4836 ; Derby, 1977 ; Dudley, 4069 ; Leamington and Warwick, 546 ; Leicester, 4102 ; Northampton, 1491 ; Nottingham, 8423 ; Oldbury, 1651 ; Peterborough, 584 ; Redditch, 1183 ; Smethwick, 4731 ; Stoke-on-Trent area, 13,878 ; Stourbridge and Brierley Hill, 4028 ; Tipton, 2240 ; Walsall, 5839 ; West Bromwich, 3205 ; Wolverhampton, 5549 ; and Worcester, 2142.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THERE is no sign of any definite improvement yet in the Manchester markets for iron and metals. In the latter there have been some fluctuations, but they are small and do not seem to indicate any general change in the situation. There is some slackening in the volume of business being done here, and this may perhaps be because anxiety is felt as to the labour position in the engineering trade. The main cause of slackness is the failure of the cotton trade to make money. When cotton is not profitable here there is no surplus to spend on machinery, and hence a revival in the prosperity of the cotton trade must precede any return to activity in what may be called the auxiliary industries. Perhaps engineers might rightfully resent the term auxiliary as applied to engineering, but in Lancashire, if nowhere else, the expression may be justified. In this district consumers seem to be holding back under the belief that prices will be easier ; and this may be the case with iron and steel ; but there is no margin for a fall of any dimensions in copper, and although any upward movement may be slow and intermittent, there is certainly more margin on the "bull" side than on the "bear" side in the market.

Metals.

On the whole, the reports from America as to the condition of the copper market there have been favourable, although there is nothing yet to induce the belief that any serious advance is near at hand. It is noticeable that any little concession in the price quickly brings out a good deal of buying, and this seems to show that consumers are fairly well satisfied with the present values, and find it worth while to buy on a slight fall. When a market is intrinsically bad every slight fall scares away the buyer, and if this be not the case in copper there is reason to believe that the market is intrinsically good. There seems to be a belief in America that copper prices will slowly improve throughout the present year, and this belief is probably based on the idea that the world is slowly but surely getting away from the disastrous results of the war, and is replacing the wealth which was then dissipated. The prices for manufactured copper and brass are unchanged, and are the subject of adverse criticism ; more especially in the cases in which much more is charged to the home consumer than can be obtained from export business. Export orders for copper sheets, for instance, have been taken recently at low prices ; and, in fact, they would have been lost unless low prices had been accepted. The scrap copper and brass market in Manchester has again been very dull. Dealers complain that there is no good outlet for scrap, and, of course, that may be because engineers are more reluctant to buy. Old gun-metal remains relatively the cheapest of the scrap non-ferrous metals. In the market for tin there has been comparatively little fluctuation. In fact, for the last fortnight tin has appeared in the new *rôle* of a steady metal. One would not yet like to trust to this steadiness, but at present no serious change is in sight. Here many people still believe in the future of the tin market. Lead has been fluctuating to a considerable extent, but it seems to have great recuperative powers. The time has scarcely come yet for a permanent relapse to more reasonable prices ; but one would not care to hold large stocks. In spelter there has been very little movement.

Pig Iron.

The market here for foundry iron is dull and listless, and there seems to be a persistent belief in the minds of consumers that a further fall in prices is coming. Of course, this belief leads to a system of hand to mouth buying, and in the end means that all, or most, of the ironfounders in the district are working on the minimum of stock. A position of this kind is favourable to sellers when any upward movement does begin ; but one cannot see any probability of such a movement at present. Derbyshire foundry iron is the main supply of the Lancashire trade at the moment, and the price is usually 87s. 6d. per ton delivered in Manchester and the immediate neighbourhood. There are still one or two makers who try for 88s. 6d., but there is an abundance of good iron at the lower price. The market is now just where it was when the fall of the Labour Government and the advent of what was thought to be a more stable form of Government gave a certain fillip to trade. It is now clear that Governments can do very little to help business, and the whole of the advance in pig iron since October has been lost again. The future of Manchester prices depends very much upon whether the Cleveland market can be sustained. Recently further weakness has shown itself there, and there is a chance that Cleveland prices may yet come down to the level of the Northamptonshire prices, say, 75s. on trucks. If this should be the case then Derbyshire can no longer be kept at 80s. on trucks, and apparently something of this sort is being anticipated by consumers in the district. East Coast hematite is easy again, and in Manchester it can be bought at about 6s. per ton less than Scotch No. 3. The latter is rather irregular, some sellers holding out for 105s. delivered, but there are others at 103s. 6d. and perhaps at 103s. In any case consumers here are using very little Scotch pig iron, and will probably not use much more until orders come in for textile machinery.

Scrap.

The market for scrap is altogether without life at present. For heavy steel melting scrap there is a small but intermittent demand from Sheffield, but dealers seem unwilling to trust to it, and are doubtful about buying here at anything more than 62s. 6d. per ton on trucks, although some dealers will pay up to 65s. Heavy wrought scrap is in small demand at about 85s. delivered, some ironworks offering only 80s. Forge pig iron can be bought at 82s. 6d. per ton delivered; but, of course, the expenses of puddling are very heavy now. In the foundry scrap market there is but little movement. The demand is slow and rather small, and there is too much foundry scrap about, some of it in weak hands. This causes the prices reported to be very irregular; but strong dealers hold out for 85s. delivered for the best kinds of cast iron scrap and 80s. to 82s. 6d. per ton for ordinary lots. The state of the demand proves fairly well that the ironfounders are not melting the average quantity of pig iron.

Institution of Civil Engineers.

The fourth annual dinner of the Manchester and District Association of the Institution of Civil Engineers was held at the Midland Hotel, Manchester, on Thursday the 19th inst. Mr. G. G. Lynde, the president of the Association, being in the chair. There was an excellent attendance of members, associate members and students and friends, including Mr. Basil Mott, the president of the Institution, and Mr. W. B. Worthington, a past-president, and the evening was a success in every way. The principal toast, "The Institution of Civil Engineers," at these dinners is always entrusted to a student, and this year the honour of proposing it was conferred upon Mr. C. R. Smith, who performed his rather embarrassing task with much credit, his speech being neatly blended with the touch of humour which is so desirable but too frequently lacking in after-dinner orations. In his reply to the toast, Mr. Mott had a good deal to say about the domestic concerns of the Institution, the finances of which he said were receiving the serious consideration of the Council. He mentioned incidentally the large annual expenditure over which the Council had no control, such as the rates and taxes, that amounted to £7000 a year. The engineering abstracts were, he said, another expensive item which was costing the Council £1000 a year. If the Council could see its way to make a material reduction in its expenditure it might be possible to reduce the subscriptions. The Council was taking considerable interest in the students of the Institution, and expressed sympathy with the difficulty which some of them experienced in getting their practical training. He recommended them to endeavour to obtain posts with contractors. The toast of the Manchester and District Association was proposed by the Lord Mayor, Mr. F. J. West, M.I. Mech. E., who referred to the high technical qualifications of the men engaged by engineering contractors. This toast was responded to by Mr. Lynde, who mentioned the responsible work which the president is engaged upon. Mr. Mott, he said, was about "to pluck Waterloo Bridge from across the Thames with one hand while supporting the dome of St. Paul's with the other." Mr. Lynde also commended very highly the officers of the Association, and particularly the efficiency with which Mr. A. C. Dean carried out his duties as honorary secretary. The toast, "Our Guests," was proposed by Professor A. H. Gibson, and replied to by the Dean of Manchester, Dr. Hewlett Johnson—formerly an engineering student.

Manchester Main Drainage Works.

I had an opportunity a few days ago of inspecting the work which is now being carried out in connection with the main drainage scheme by which the drainage of the whole city and certain adjoining districts will be effected. This scheme includes about 30 miles of sewers, of which about 18¼ miles have been completed, and on which £1,115,000 has already been expended. The portion inspected extends for about 4 miles, and the sewer varies in diameter from 4ft. 9in. to 12ft. It is constructed of brickwork in cement mortar, except for a length of 1000 yards, where it is of cast iron on account of the nature of the ground through which this portion passes. The greatest depth below the surface is 143ft. At the two portions which I visited the excavation is being carried out by hand pneumatic tools in red sandstone, and the sewer is 12ft. diameter. The lower half of the tunnel is carried out in Accrington bricks, and the upper portion in shale bricks. The quality of the bricklaying is excellent. The work will involve crossing under two railways and two canals. Twelve working shafts have been or will be sunk, and from the bottom of these the tunnel is driven, the greatest distance between the working shafts being 3700ft. The contract is being executed by Edmund Nuttall, Sons and Co., Limited, under the supervision of the city engineer, Mr. J. B. L. Meek, M. Inst. C.E., and the total cost will be £385,592 for this portion of the work.

BARROW-IN-FURNESS.

Hematite.

There is no change to report in the hematite pig iron trade, which continues to show a lack of life. There is an absence of orders for forward delivery, and present trade is to a very large extent confined to orders for immediate requirements. There are various reasons for this condition of things, including the prevailing unsettled condition of labour in various branches of industry. The steel works at Barrow and Workington continue to take a considerable amount of the iron produced, and if there is a stoppage for any considerable length of time in the steel departments there would certainly be a restriction of output. The home trade is largely done with the Midlands, for Scotland is not ordering the tonnage she did. Continental trade is dull, but there was a shipment of pig iron last week from Barrow to Porto Vecchio and also to Treport. North Wales is taking small cargoes also at intervals. The American trade is uncertain, but there is still a promise of some business.

Iron Ore.

There is a slight falling off in trade in local ores due to the poorer demand from buyers outside the district. The Scotch business is not so brisk because of the stoppage of some furnaces over the border. Business in foreign ore continues to be steady, but the demand is not heavy.

Steel.

There is nothing fresh to report of the steel trade. Neither the Barrow nor the Workington rail mills are well off for orders, but for some time the mills at Barrow have been kept going regularly, whilst in Cumberland they have not been so steadily employed. Small section and hoop mills at Barrow are better situated. Plates and rivets have arrived in Barrow from Rotterdam.

Shipbuilding and Engineering.

On Tuesday Vickers, Limited, launched from their shipyard at Barrow the steamer Caranthia. She has been built for the Cunard Line, and is 630ft. long with a displacement of 27,000 tons. She will be fitted with turbine engines and will maintain a speed of 16 knots.

SHEFFIELD.

(From our own Correspondent.)

Steel Buyers Holding Off.

With the exception of acid steel, for which there is a demand following the call for railway material, the buying of billets is at a very low point, and is only on a scale sufficient to meet immediate needs. Buyers are marking time, and the blast-furnaces and basic steel open-hearth furnaces are experiencing great difficulty in avoiding a further curtailment of production. Steel billets and pig iron are being placed in stock, and the position generally is anything but hopeful. Work is being found for the rolling mills, but they are using Belgian basic material, the product of their own district, unfortunately, being too expensive, in light of the quotations they have to give to secure orders. The market for iron and steel scrap reflects the stagnancy at the furnace centres in the Sheffield district, and in Lincolnshire and Derbyshire. The price of low sulphur and phosphorus acid steel scrap is fully maintained, but in practically all other classes prices are weakening, owing to the absence of anything but casual business, and this on terms in buyers' favour.

Lighter Steel Trades.

Conditions are irregular in the lighter sections, some firms being slack while others are busy. In the latter case, however, complaints are frequently heard about the smallness of profits, a good deal of work being taken at severely cut rates. The tool trade is not making much headway, but the colonial market is inclined to buy more freely, delivery of the highest quality goods being generally required. There are several points of interest to note with regard to the file trade. Mr. Storry Deans, Member of Parliament for one of the Sheffield divisions, has been informed by the Department of Overseas Trade that the latest advice from Lisbon indicates that the Portuguese are likely to increase the duty on Sheffield files, despite British protests. According to the evidence given before the Balfour Committee on Trade and Industry, the output of files, although only about 70 per cent. of the capacity, is in advance of that of the immediate pre-war years. The explanation of this fact, of course, is that a good deal of additional plant was put down during and after the war. The supply of skilled labour is at present adequate, but it would not be so in the event of a substantial improvement in trade.

Sheffield Trade Handicaps.

In addition to files, a good deal of valuable information was given before the Balfour Committee on the city's trade generally. Those who gave evidence were Mr. J. H. Doncaster, President of the Chamber of Commerce; Mr. A. S. Pye-Smith, a member of the Management Committee of the File Manufacturers' Association; Mr. C. W. Kayser, President of the Crucible Steel Makers' Association; Mr. J. G. Elliott, President of the Sheffield Cutlery Manufacturers' Association; and Mr. T. G. Mander, secretary of the Engineering Employers' Association. These gentlemen fully explained the handicaps under which Sheffield trade is labouring to-day. They showed that fuel is costing from 86 to nearly 150 per cent. more than pre-war, that foreign tariffs are making trade in some cases impossible, that preference granted by the Dominions has been an advantage to the city and that an extension of it would be welcomed, that labour output has been reduced with restrictions on apprenticeship in some sections, and that an additional burden in meeting foreign competition is imposed by the heavy local and national taxation. With difficulties such as these to face the wonder is that Sheffield trade maintains even its present level. Yet it says a great deal for the foresight of those at the head of the industries of the city that no large firm has failed to keep its head above water. Provision for bad times was made in good.

Cutlery and Plate.

The cutlery and plate trades are fairly busy in the cheaper lines for the home market, and though conditions generally should be a great deal better they are in a healthier state than they were a year ago. The output of table knives, chiefly stainless, has reached very large proportions. In the pen and pocket-knife and scissors departments there is only moderate activity. Safety razor blades of Sheffield manufacture are making steady headway, and are quietly building up a reputation for reliability certainly equalling, if not surpassing, that of the American product. Ordinary razors, however, are in poor demand, and the market for them is too small to allow of any substantial improvement. There is a steady sale for the medium classes of electro-plate, but the home trade for the best makes and for silver-ware is extremely quiet. The colonial trade, however, remains steady, with a tendency towards an improvement, judging by inquiries and agents' reports.

New Coke Ovens.

The South Yorkshire Chemical Works, at Maughan, near Parkgate, is receiving important additions. Sixty new coke ovens are being put down, and extensive alterations are being made to the existing plant. It will take about two years to finish the work. A supply of gas from the Rotherham Corporation works has been arranged for, and the mains are now being laid.

Opposition to Railway Scheme.

A few weeks ago I referred to the proposals to develop railway communication in the beautiful Sherwood Forest area, to which there has been considerable opposition. The latest opponent is the town of Retford, the authority of which has agreed to present petitions to Parliament against the Bills promoted by the London and North-Eastern and the London, Midland and Scottish railway companies. With that of the former the Corporation is in general agreement, greater opposition being shown to the London, Midland and Scottish Railway project. When this matter was debated, one of the speakers not in agreement with the petitions pointed out that before long four new collieries would be producing 5000 tons of coal a day each. This would necessitate 100 more trains a day, and one railway company, he contended, could not cope with this call.

Delayed Sewage Scheme.

A deputation from Dewsbury Corporation has discussed with the West Riding Rivers Board the position of the Corporation's proposed new sewage works at Mitchell Laithes. The Board has been complaining of the slow progress being made with the scheme, and has made a move towards applying for certain penalties. On behalf of the deputation, the Town Clerk of Dewsbury explained that the Corporation had already completed a storm relief sewer at a cost of £15,064. Pumping plant costing £4175 was ready at the maker's works, and a cast iron rising main, costing £6145, had been completed. In addition, they had agreed to let a contract for humus tanks, amounting to £18,564. A sum of £61,074 had been expended, with contracts running amounting to £34,767, but the full expenditure sanctioned is £201,000. The deputation agreed to give an undertaking that within three months it would start the humus tanks, and would commence the work for the alteration of the pump-house buildings.

Leeds Engineering Feat.

In constructing the 7-mile main arterial sewer for Leeds, a big engineering feat is being accomplished, and though the work is now in progress under the centre of the city, there is very little evidence of it to be seen by the general public. Practically the whole of the work is being carried out by tunnelling, with a shaft here and there. The shallow depth of the sewer will necessitate an open cut for about half a mile.

Transport Problems.

A special sub-committee of the Leeds Tramways Committee, which has been investigating the question of transport, has given an expression of opinion that for mass transportation the tramway must remain the chief means of street transit. Recognising that the motor omnibus has proved, and will continue to prove a valuable auxiliary to tramways, the committee proposes to make the fullest use of this type of transport, both as a feeder to the trams and for the purpose of developing new routes. In view of this report, the Tramways Committee has decided that specifications be prepared and tenders invited for 150 new tramcars, and that a further 50 cars be built in Leeds.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

The outlook in the Cleveland pig iron trade has been made appreciably brighter this week by the placing of an order for a fair quantity of foundry iron for immediate shipment to Hamburg. This sale is important as indicating that Cleveland makers have at last got down to competitive level. Continental prices are undoubtedly stiffening—the French makers have, in fact, fixed minimum home prices—and it would seem to be possible for Cleveland to regain a foothold in European markets. There is also a probability of more business with America, and it is understood that one or two inquiries are already circulating. Moreover, with the spring the Baltic ports will be reopening, and that may provide a further outlet for Cleveland iron. Thus the tone of the market is much less despondent, even though the downward trend of prices has not yet been completely checked. Home consumers have been holding off the market since the turn of the year, but a number of contracts are now approaching the point of exhaustion, and these will no doubt have to be renewed. At all events there is just a little more inquiry on home account, and a few more export sales would probably immediately stimulate the market all round. No. 3 G.M.B. Cleveland pig iron is 78s. 6d., No. 1 83s. 6d., No. 4 foundry 77s. 6d., and No. 4 forge 76s. 6d.

Hematite Pig Iron.

Little improvement is recorded in the East Coast hematite pig iron trade. There is still a very limited demand, the slackness at the steel works having curtailed the consumption, and some makers hold heavy stocks. There is keen competition for orders, and mixed numbers are freely offered at 85s. 6d., with No. 1 at 86s. per ton, a drop of 6d. per ton on the week.

Ironmaking Materials.

There is no general demand for foreign ore, and only an occasional spot cargo can be sold at 22s. per ton c.i.f. Tees, which represents probably a minimum figure for best Rubio ore. The fuel market is still very weak, and whilst the best Durham brands of blast-furnace coke command 24s. per ton delivered at the works, it is possible to purchase rather below that figure.

Manufactured Iron and Steel.

There seems to be more inquiry in the manufactured iron and steel trade, but many of the works on the North-East Coast are badly in need of orders, and outputs are much reduced. Prices, however, remain generally unchanged.

The Coal Trade.

There is no improvement in the Northern coal trade position, and generally each day sees business become of a more restricted character. The situation throughout the whole area is very discouraging, and new business exceptionally scarce. Contractors, who are not a numerous body this year, and who have not any large quantities to dispose of, are offering supplies very freely at the recent range of prices. Fitters direct quote a little above the normal market value, but there are very few transactions, and on the whole prices are not thoroughly tested. Through lack of demand there is a steady reducing of output, and by this means prices are kept round about late figures, and with little prospect of improvement operators are not taking any sanguine view of the forward position, and quote freely on the basis of current values for any position. Speculators on the Continent take an even worse view, and are snapping up what little business is offered at shillings below what sellers on this side will entertain. The pressure of German coals is particularly severe, and competition from the American side is also keen, but if there were trad: local operators maintain that, at present prices, a good average percentage would come here, owing to the more reliable qualities of the coal supplied. The London gas companies are stated to have contracted direct with various Durham collieries for the supply of their usual average quantities of gas coals over the next twelve months. The prices are stated to be on the basis of 20s. 6d. to 21s. for best and special qualities, and 18s. for ordinary classes. The market for coke remains idle, and new inquiries are scarce. All makers report production in excess of orders, and stocks steadily increasing.

SCOTLAND.

(From our own Correspondent.)

Stagnation.

NOTHING of a fresh nature has occurred during the past week, and there is evidently no immediate prospect of a change for the better in the steel, iron, and coal trades. A scarcity of specifications and a lack of orders are reported on all hands, notwithstanding the efforts of producers from time to time to meet buyers in the matter of price. Unfortunately, the best terms possible on behalf of home manufacturers are still somewhat higher than foreign rates for similar materials, and even when home producers quote terms which would entail a slight loss, they invariably find themselves out of it in the matter of price. In almost all districts and in practically all industries embracing steel and iron manufacture, and in the coal trade, the advisability of closing establishments until such time as trade seems to be on the mend is under most serious consideration. Markets show little variation from day to day and week to week, and interest in proceedings is difficult to sustain. As has been said here before, the scarcity of specifications from shipbuilding firms on the Clyde is a great disappointment to many, and contributes in no small degree to the lack of activity in the West of Scotland generally. Two or three orders for new vessels have just been reported, but many such contracts are required to fill the berths vacated during the past few months and provide the employment the yards are capable of accommodating. Until costs of production permit and labour questions settled, there seems no hope of increased activity in a most vital industry.

Steel and Iron.

Latest reports from the steel and iron trades embody the statement reiterated times almost without number that foreign competition is throttling trade in overseas markets and at home. Not only do makers find themselves at a disadvantage in foreign markets, but are also confronted with considerable importations of competitive material. Steel plates and sections are extremely slow, and the mil s are employed far below capacity. The recent reduction of 7s. 6d. per ton in steel rails has been of no practical benefit so far, the prices of imported material being still too great an inducement to buyers. It is still left to steel sheets to provide the exception to the general rule, and even in this industry the lighter sheets are much busier than the heavy description. Light black and galvanised sheets are very busy, especially the latter. The bar iron market is very short of orders, and re-rolled steel also is similarly placed. Dealers in scrap feel the pinch and prices are not so firm. So far as pig iron is concerned, the production has already been severely curtailed, and still stocks accumulate, consequently a further damping down of furnaces may be expected. Prices are nominally unchanged, but a weaker tendency is apparent.

Coal.

The depression in the Scottish coal trade has reached a most acute stage owing to the unprecedented lack of export orders. Collieries in all districts are affected, but perhaps it may be said that the East of Scotland is most deeply affected, as the output from there is normally disposed of in foreign directions. For some time now many have been selling practically at a loss in order to dispose of stocks, but cannot do so indefinitely. Therefore, in a number of cases notices of a stoppage have been posted. Prompt export business has dwindled seriously, while prices have dropped considerably, and, on the other hand, forward transactions have been almost impossible even when exporters have expressed a willingness to discount prices. Cheap continental prices and the increasing outputs there have played havoc with home collieries. The markets here are extremely dull, practically the only bright spot being the demand for best Lanarkshire splints for shipment to Italy. This fuel has maintained a firm standard. At the same time washed fuels have been sold to the same country at cheap rates. Aggregate shipments for the past week amounted to 246,639 tons, against 214,552 tons in the preceding week, and 205,858 tons in the same week last year. The home trade remains far below par owing to the general trade depression.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE conditions in the steam coal trade continue to be dull, and there appears to be no immediate prospect of an improvement, as the demand from abroad is anything but satisfactory. Continental buyers are very scarce, and when they are interested in supplies from this district their prices as a rule are so low that exporters are unable to entertain their offers without a grave risk of making a loss instead of a profit. The position is a very serious one, not only for the middlemen, but also for the collieries, as the latter, except in a few cases, cannot work regularly, and, owing to the accumulation of stocks, intermittent working at the pits means an addition to their costs of production. At the beginning of this week there were more idle berths at the docks than steamers waiting to load, which was a very poor start, and as bad weather prevailed, preventing the arrival of tonnage as promptly as was expected, the prospects were that the loading arrangements of the collieries would be further dislocated. In the circumstances the indications were that work at the pits would continue to be very irregular, with consequent unevenness in market prices for supplies for quick shipment. At the moment there are only two inquiries on the market of any note, one being that of the Egyptian State Railways for 150,000 metric tons of Admiralty and Monmouthshire large coals, which have to be shipped during May, June and July to Alexandria. The period of delivery is interesting, as it is immediately before the time when trouble with the miners may be expected, if there is to be any. The other inquiry is one of 10,000 tons of locomotive coals for the Sudan Railways for March shipment.

Coalfield Items.

There seems to have been some expectation in certain quarters that steps might be taken to bring about a resumption of work at the Cambrian pits at Clydach Vale, which have been idle since August last. A mass meeting of the workmen was held on Monday last to consider the question of making a movement and approaching the management, but a large majority of the workmen expressed themselves as against initiating negotiations, so apparently nothing is to be done. From the owners' point of view, it is questionable whether the time is opportune to reopen the pits, as the present conditions are quite as bad now, if not worse, than they were when the collieries were closed down. The position is undoubtedly very serious, as may be gauged from the fact that the announcement was officially made at the beginning of this week that notices to cease work were to be served on about 1000 men employed at the Vivian Colliery at Abertillery, which is controlled by the Ebbw Vale Company. Trade depression is the cause of this action. The Grey and Tillery pits, under the same concern, are already idle, so that the closing of the Vivian Colliery will mean that altogether about 5000 workmen will be rendered idle. About 1000 men are affected by the suspension of work until further notice of the International Colliery, Blaengarw, in the Garw Valley.

South Wales Miners and Wages Agreement.

The conference of delegates of the South Wales Miners' Federation called specially to consider the recommendations of its Executive for the suggested amendment of the wages agreement on Saturday last, decided to instruct its delegates to the National Conference at Blackpool to vote in favour of ending the agreement. This is not the first time that a delegate conference has gone contrary to the proposals of its Executive, though at the same time it may be said that it has not always been the case that a delegate conference has truly interpreted the feelings of the rank and file of the coalfield. The chairman of the conference referred to the coalowners' panacea for remedying the present conditions in the coal trade, viz., an increase of the working day, and said that that was not acceptable to the miners, who were confident that the desired improvement could not be obtained in that way. The card vote taken on the Executive's proposals resulted in 1229 being for and 1404 against, these figures representing 61,450 for the proposals and 70,200 against.

Tin-plate Developments.

Reference has already been made to the proposed developments at Swansea contemplated by Baldwins, Limited, and it is now announced that the Glamorgan Tin-plate Company has been registered as a private company, with a nominal capital of £200,000 in £1 shares. The directorate is to be divided between Baldwins, Limited, and the Anglo-Saxon Petroleum Company, and the number of directors is not to be more than six nor less than four. The directors' borrowing powers are restricted to £200,000, unless sanctioned and enlarged by resolution of the company. The intention is to erect entirely new and modern tin-plate mills and steel works at the Swansea Burrows. The Anglo-Saxon Petroleum Company is a consumer of oil containers, which it will obtain from the new works.

Tin-plate Workers' Wages.

An award has been given by the sub-committee of the Joint Standing Committee in the Welsh tin-plate trade to the effect that all able-bodied labourers receiving the 5s. a day advance granted in September, 1923, and who are outside the line of promotion, are to receive a further advance of 10 per cent. on their base rates. This is applicable only to men whose present base rate is from 5s. to 5s. 6d. per day. The percentage of advance on intermediate rates is on a *pro rata* basis.

French Inquiry.

The French State Railways are in the market for 40,000 tons, consisting of 10,000 tons of large and 30,000 tons of small coals for shipment over the next three months.

Current Business.

Business on current account has been of very modest dimensions during the past week, and there has been very keen competition for the few orders available. The tone of the market all round has been quiet, and values of most descriptions have been irregular, especially for prompt loading, owing to the fact that standing stocks have been so heavy. Collieries have been only too ready to make concessions to those buyers able to take quick delivery, though few have been in the fortunate position of being able to do so. In the anthracite section the conditions have also been rather on the quiet side, though there is a slightly better outlook.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are asked to announce that Mr. H. S. Aspinall, general manager of Vickers-Petters, Limited, has been appointed a director of that company.

THE FOSTER ENGINEERING COMPANY, Limited, of Morden Works, Wimbledon, S.W. 19, informs us that it has appointed Mr. F. Routledge, 21, Temple-lane, Dublin, as agent for the sale of its products in Ireland.

WE are asked to state that, following the death of Mr. John M. Henderson, chairman and managing director of John M. Henderson and Co., Limited, of Aberdeen, arrangements are being made to secure the continuity of the business on the same lines as hitherto. So soon as the necessary formalities permit, the family of the late Mr. Henderson, who are retaining their late father's interest in the company, will be represented on the board of directors.

THE PREMIER ELECTRIC WELDING COMPANY, Limited, asks us to state that it has decided to discontinue the carrying on of business from its Swansea establishment, but that arrangements are being made at the same time to extend the company's facilities at its Abbey Wood Factory, London, S.E. 2, for the manufacture of its various products. The company is managed and directed solely by Nobel Industries, Limited.

MR. E. HARLAND HUTCHINSON, who has for many years specialised in burning coal in pulverised form, has accepted an executive position with Vickers and International Combustion Engineering, Limited, of Africa House, Kingsway, W.C. 2. He will have charge of developments of the firm's interests in the Dominions and Colonies, and is shortly proceeding to Australia, *viâ* the United States of America and Canada.

WE are informed by British Insulated and Helsby Cables, Limited, that it has been decided to change the name of the British Union lamp, which it manufactures in its lamp factory at Huyton Quarry, near Liverpool, to the B.I. lamp, the new name being the first two initial letters of the cable company's title. The B.I. lamp will carry the firm's trade mark, which has hitherto characterised all the Helsby and Prescot products.

THE STILL ENGINE COMPANY, Limited, informs us that, it having been decided to concentrate the administrative and designing work of the company in the same building as its research laboratory, the offices of the company have been moved from 7, Princes-street, Westminster, to Church Wharf, Chiswick, London, W. 4, to which it requests that all communications should be sent in future. Telephone: Chiswick 1300; telegrams: "Nuprimover, Phone, London."

CONTRACTS.

YARROW AND CO. (1922), Limited, of Scotstoun, Glasgow, have received from the London Electric Supply Company an order to supply its latest type Yarrow water-tube boiler, together with superheater and air heater, for the power station at Deptford.

THE GENERAL ELECTRIC COMPANY, Limited, of Magnet House, Kingsway, London, W.C. 2, has received from the Admiralty an order for the supply of 50,980 special Robertson carbon filament lamps, and from the General Post Office an order for 10,000 special telephone switchboard lamps.

HOWDEN-LJUNGSTROM PREHEATERS (LAND), Limited, has received, from Chance and Hunt, Limited, chemical manufacturers, Oldbury, near Birmingham, an order for a preheater, having a total heating surface of 17,500 square feet. Air will be supplied to the furnace at about 375 deg. Fah.

H. R. MARSDEN, Limited, of Leeds, has recently received the following orders:—For a complete breaking, screening and quarry plant from the Ross and Cromarty County Council, Mid-Ross District Committee, Dingwall; and for complete breaking, screening and tar-macadam plants from the Berwickshire County Council, Middle District Committee, and the Southern District Committee of the Kirkcudbright County Council.

THE VICKERS-SPEARING BOILER COMPANY, Limited, Bank-buildings, 20, Kingsway, London, W.C. 2, has recently received a repeat order for three 15,000 lb. cross-type water-tube boilers, from the Anglo-Scottish Beet Sugar Corporation, for its Nottingham factory, as well as a repeat order from the Wimbledon Corporation electric supply department for one 50,000 lb. cross-type boiler, fitted with an Illinois chain grate stoker and flat suspended arch.

VICKERS LIMITED, of Barrow-in-Furness, have recently received the following orders:—(*a*) From the Associated Portland Cement Manufacturers for three kiln shells, each 250ft. long, which will be the largest yet installed in this country, for Bevan's works; (*b*) for a condensing plant to be installed in connection with the new 6000-kilowatt turbo set recently ordered by the Brighton Corporation; and (*c*) for a low-pressure flash-evaporating and de-aerating plant for use in connection with the power station extensions for the Poplar Borough Council, which are being carried out by Vickers and International Combustion Engineering, Limited, as main contractors.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 12 6	—
No. 1 Foundry	4 11 6	—
No. 3 Foundry	4 9 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 5 6	4 5 6
No. 1	4 6 0	4 6 0
Cleveland—		
No. 1	4 3 6	4 3 6
Silicious Iron	4 3 6	4 3 6
No. 3 G.M.B.	3 18 6	3 18 6
No. 4 Foundry	3 17 6	3 17 6
No. 4 Forge	3 16 6	3 16 6
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
,, Forge	3 10 0	—
(3) Derbyshire—		
No. 3 Foundry	3 19 0 to 4 0 0	
Forge	3 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 2 6	—
No. 4 Forge	3 17 6	—
Basic	4 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 0 0 (a) / 5 5 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best ,,	—	—
N.E. Coast—		
Common Bars	12 0 0	—
Lancs.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 15 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	11 15 0	—
Gas Tube Strip	13 0 0 to 13 2 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ½in. and up	9 15 0	—
Sections	9 10 0	—
Steel Sheets, 3/16in. to ½in.	12 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	£18 0 0 to 18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 5 0	—
Angles	9 0 0	—
Boiler Plates	13 0 0	—
Joists	9 5 0	—
Heavy Rails	9 10 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 0 0†	—
Light ,,	9 5 0 to 9 10 0	
Billets	8 0 0 to 11 0 0†	
Manchester—		
Bars (Round)	9 15 0 to 10 0 0	
,, (others)	9 10 0 to 9 15 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	9 10 0 to 9 15 0	
,, (Lancs. Boiler)	13 0 0	—
Sheffield—		
Siemens Acid Billets	11 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 0 0 to 8 5 0	
Hoops	12 0 0	—
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	9 0 0 to 9 15 0	
Billets and Sheet-bars	7 0 0 to 7 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 0 0 to 17 5 0	—
Angles	9 5 0	—
Joists	9 5 0	—
Tees	10 5 0	—
Bridge and Tank Plates	9 15 0	—
Boiler Plates	13 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/- to 23/6
Block Tin (cash)	262 7 6
,, (three months)	265 5 0
Copper (cash)	63 0 0
,, (three months)	63 17 6
Spanish Lead (cash)	38 1 3
,, (three months)	36 15 0
Spelter (cash)	37 1
,, (three months)	36 6 3
Manchester—	
Copper, Best Selected Ingots	70 0 0
,, Electrolytic	71 10 0
,, Strong Sheets	96 0 0
,, Tubes (Basis Price)	0 1 1½
Brass Tubes (Basis price)	0 1 0½
,, Condenser	0 1 2½
Lead, English	40 10 0
,, Foreign	39 0 0

FERRO ALLOYS.

(All prices now nominal.)

Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 10 0	7/9
,, 8 p.c. to 10 p.c. ,,	£23 0 0	7/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£42 0 0	16/-
,, ,, 1 p.c. ,,	£52 0 0	17/6
,, ,, 0.75 p.c. carbon	£58 0 0	20/-
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 unit	scale 5/- per
,, ,, 75 p.c.	£19 10 0 unit	scale 6/- per
,, Vanadium	17/- per lb	
,, Molybdenum	7/3 per lb.	
,, Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£175	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	16/9
,, ,, Ell	16/6
,, ,, Splint	22/6
,, ,, Trebles	17/6
,, ,, Doubles	16/6
,, ,, Singles	14/3
Ayrshire—	
(f.o.b. Ports)—Steam	16/9
,, ,, Splints	19/-
,, ,, Trebles	17/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	14/9 to 17/-
Screened Navigation	23/6
Trebles	16/3
Doubles	15/9
Singles	14/3
Lothians—	
(f.o.b. Leith)—Best Steam	16/6
Secondary Steam	15/6
Trebles	15/9
Doubles	14/9
Singles	13/6

ENGLAND.

(8) N.W. Coast—	
Steams	28/6
Household	45/- to 59/4
Coke	30/-
Northumberland—	
Best Steams	18/6
Second Steams	17/6
Steam Smalls	10/9
Unscreened	15/6 to 16/6
Household	23/6 to 25/-
Durham—	
Best Gas	21/-
Second	17/9 to 18/-
Household	23/6 to 25/-
Foundry Coke	23/- to 23/6
Sheffield—	Inland.
Best Hand-picked Branch	30/- to 33/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	26/- to 31/- —
,, ,, House	24/- to 26/- —
,, ,, Large Nuts	22/6 to 25/- —
,, ,, Small	14/- to 16/- —
Yorkshire Hards	19/6 to 23/- —
Derbyshire ,,	19/6 to 22/- —
Rough Slacks	10/- to 12/6 —
Nutty ,,	9/- to 10/6 —
Smalls	4/- to 6/6 —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o.b. 20/9 to 21/9

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	26/3 to 27/-
Second ,,	25/- to 26/-
Best Dry Large	25/6 to 26/-
Ordinary Dry Large	24/- to 24/6
Best Black Vein Large	24/- to 24/6
Western Valley ,,	23/- to 24/-
Best Eastern Valley Large	23/- to 24/-
Ordinary ,, ,,	22/6 to 23/-
Best Steam Smalls	16/- to 16/6
Ordinary ,,	13/- to 15/-
Washed Nuts	22/- to 28/-
No. 3 Rhondda Large	27/- to 27/6
,, ,, Smalls	17/- to 18/-
No. 2 ,, Large	22/- to 23/-
,, ,, Through	18/- to 20/-
,, ,, Smalls	11/- to 13/-
Foundry Coke (export)	40/- to 47/6
Furnace Coke (export)	25/- to 30/-
Patent Fuel	24/- to 26/6
Pitwood (ex ship)	23/6 to 24/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	43/6 to 45/6
Seconds	32/6 to 35/-
Red Vein	30/- to 32/6
Machine-made Cobbles	45/- to 50/-
Nuts	50/- to 52/6
Beans	44/- to 45/-
Peas	20/- to 23/6
Breaker Duff	9/- to 9/6
Rubbly Culm	9/6 to 10/3
Steam Coals:	
Large	22/- to 24/-
Seconds	21/- to 22/-
Smalls	10/- to 13/-
Cargo Through	16/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated.

Coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 16/9, with fluctuations according to analysis; open market, 18/- to 19/- at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Iron and Steel Combines.

THE efforts of iron and steel producers to combine for the maintenance of prices and the distribution of home and foreign orders have so far given little tangible result. There are always some firms which fear that such a distribution would imply the handing over of some of their business to others. The one successful effort has been the fixing of minimum prices for pig iron, as well as for some descriptions of rolled iron, but the sole result has been to keep off buyers who are merely satisfying their pressing needs, until such time as the situation becomes clearer. Meanwhile, there can be no question of a permanent minimum, for coal prices are rising, and it is fairly certain that coke from the Ruhr will advance, while there are so many other factors, such as wages and higher transport charges, that it is quite impossible to give any indication of the future. Under present circumstances, any attempt at combining to regulate prices has little chance of stimulating business.

Capital and Trade.

Industrial activity is beginning to decline from a variety of causes, and more especially from the reluctance of capital to engage in industrial undertakings. While so much money has gone to the State in the form of loans, and so much is reported to have been invested abroad, there is practically nothing available for industry, and the lack of discount facilities has made the position of manufacturers a very difficult one. A crisis can only be averted by reviving confidence in industrial investments. This the Government proposes to do by a variety of expedients, such as the redeeming of war bonds at their face value without interest, which means that the bonds will rank as banknotes. Holders of bonds will therefore have no inducement to keep them unproductive, and will be encouraged to invest them in industrial and other undertakings. By releasing this enormous capital, it is hoped that a very large proportion of the money will help to bring about an industrial revival.

Decorative Arts.

The buildings being constructed for the International Exhibition of Decorative Arts are of less engineering interest than exhibition buildings generally are, for the reason that there are no big constructions necessitating the intervention of the engineer. Each country has a pavilion of its own, which will offer an extraordinary variety in architectural effect, and the Exhibition will probably be, in a general way, the most artistic yet held. Interest in building construction lies in the absence of the usual plaster and fibrous material, and in the employment of methods now being so largely used for the erection of cheap buildings. Some are built with hollow bricks, faced with cement, and the fine Italian pavilion is a particularly solid edifice, as exhibition buildings go. In some cases the material used consists of huge conglomerate blocks, obviously made of clinkers and rubbish, and elsewhere conglomerate bricks are employed for walls and concrete for arches, balustrades and steps. Several pavilions are built entirely of wood. There is very little metallic construction, and not much more concrete, except for pillars, and at the Place de la Concorde entrance there are eight huge square concrete towers arranged in a circle apparently to support a dome. The general effect of the Exhibition promises to be exceptionally good.

Paris Water Supply.

The proposal to draw a practically unlimited supply of water for Paris from the vast reservoirs which the Municipal Council is in favour of constructing in the upper valley of the Seine, with a view principally of regulating the river level and preventing periodical floods, does not meet with the approval of the Scientific Commission for the Control of Water in Paris. That body has declared against the water being brought to Paris, and recommends the carrying out of the scheme for tapping the subterranean water in the Vals de Loire, while it states that the underground water resources in the upper valley of the Seine may be worth investigation. The construction of barrages for flood reservoirs would entail a huge expense, which some experts declare might be avoided by a systematic programme of afforestation. It is regarded as fairly certain that the destruction of woods and forests is partly responsible for the more frequent flooding of the Seine, and, as a temporary expedient, subsidies are being granted to communes which undertake to plant trees in the Seine Valley.

Seamen's Hours.

Notwithstanding the obvious difficulty of imposing an eight hours' working day in the merchant marine, the present Socialist Government has made up its mind to apply the law in its entirety. So far, the law has remained in abeyance in the hope that other countries would be induced to adopt a similar measure, for it was evident that if the law were only applied here it would place French shipowners in a much more serious position. Shipowners are already burdened with restrictions that do not exist elsewhere, and an eight hours' working day would impose such heavy additional charges upon them that competition for freights would become impossible. The Government offers to meet the difficulty by paying subsidies to cover the extra charges following upon the application of the eight hours' working day, but the Société des Armateurs de France has informed the Prime Minister that it has no faith in the ability of the Government to pay subsidies, and that even though the losses were covered, the eight hours' working day would be quite impracticable on board ship, and that, in effect, they will have nothing to do with it under any circumstances whatever. It insists upon the present Government maintaining the arrangement entered into with its predecessor. The opposition of the shipowners to these Socialist reforms promises to be as uncompromising as that of the railway companies.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

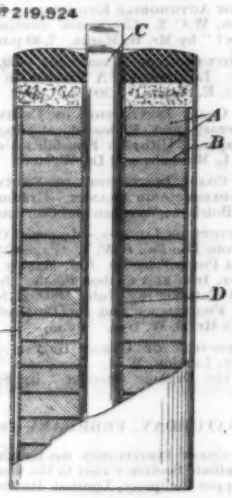
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

BATTERIES AND ACCUMULATORS.

219,024. January 21st, 1924.—IMPROVEMENTS IN AND RELATING TO DRY CELLS. *The Manhattan Electrical Supply Company, Inc., of* 17, *Park Palace, New York City, U.S.A.*

A dry cell constructed in accordance with this invention consists of tablets A composed of a depolarising mixture and sepa-

Nº 219,924



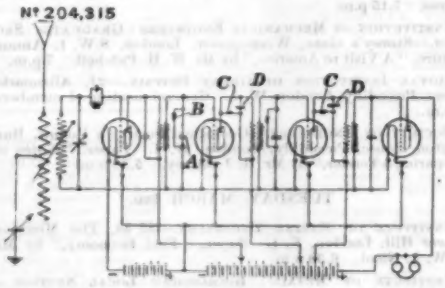
rated by thin layers of graphite B. The carbon rod C is surrounded by a cylindrical layer of graphite D. The tablets are staked one on top of the other and are surrounded with a cellulose container E. The space F between the container E and the zinc is filled with flour paste.—*January* 15*th*, 1925.

TELEGRAPHS AND TELEPHONES.

204,315. September 3rd, 1923.—RADIO RECEIVING APPARATUS, *Johnson-Williamson Laboratories, of* 609, *West Lake-street, Chicago.*

This specification describes a scheme for eliminating the effects of static and other disturbances in telephone receivers. A great portion of the specification is devoted to the general description of the receiver, which is pretty obvious from the diagram. One of the special features, however, is the provision of a condenser A and high resistance B connected across the secondaries of the transformers as shown. The condensers C and resistances D in each of the intermediate circuits affords a path of low resistance for static and other waves of high frequency. The action of the condensers A is to demagnetise the core of the transformer more

Nº 204,315

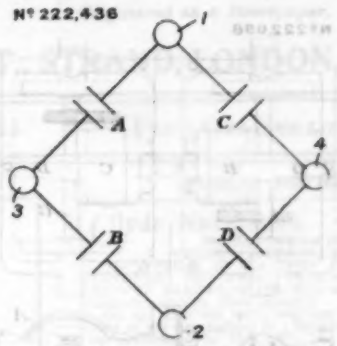


rapidly, thereby making it susceptible to rapid alternating currents. This improves the transmission of the audible or voice frequencies. It also tends to keep clear or fully discharge the grid at the point of neutrality or the zero value of the E.M.F. and current. Moreover, high frequencies, such as internal tube oscillations, static and other foreign disturbing currents, find a path of small resistance through the condenser A and currents of high voltages with high audible frequencies of about 15,000 cycles, such as will produce a shrill note, find a route of small resistance through the high resistance B. High frequencies caused by oscillating valves are completely shunted out of the grid by this shunt, thus making it possible to employ a much higher ratio of transformation than has hitherto been used.—*January* 5*th*, 1925.

222,436. September 26th, 1923.—A METHOD OF REDUCING CROSS TALKING IN TELEPHONE CABLES, Felten and Guilleaume Carlswerke Actien-Gesellschaft, of Kola-Mülheim, Germany.

This invention relates to a method of reducing cross talking in telephone cables and more particularly in double telephone circuits or phantoms. The inequalities of the effective part capacities of the conductors having an influence upon one another are compensated by correspondingly balancing the part capacities in a short portion of the length by altering the dielectric conditions between the conductors. Let it be assumed that the phantom illustrated is to be balanced. Measurements have shown that the effective part capacities A, C, and D have to be increased by 120 cm., 80 cm., and 150 cm. respectively in order to make them equal to the part capacity B. The conductors 1 and 3 corresponding to the capacity A, 1 and 4 corresponding to the capacity C, and 2 and 4 (capacity D) are firmly pressed together respectively by bindings until measurement of the whole phantom gives A = B = C = D. In order to reduce the length over which the binding is applied, the following method may be adopted. The largest capacity part B is first of all reduced by forcing the conductors 2 and 3 away from one another by means

Nº 222,436



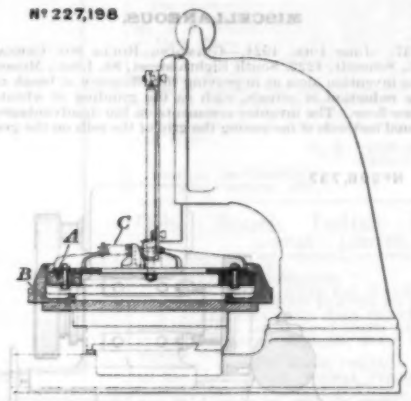
of a suitable insertion, until B = C, and thereupon A and D are increased until they are also equal to C, the increases then amounting only to 40 cm. and 70 cm. respectively.—*January* 22*nd*, 1925.

TRANSMISSION OF POWER.

227,198. October 11th, 1923.—GRINDING GEAR WHEELS, The Hon. Sir C. A. Parsons, S. S. Cook and J. Ford, Heaton Works, Newcastle-on-Tyne.

This invention might be described as a lapping process for producing toothed gears with a high degree of accuracy. The gear A to be lapped is surrounded by a similar internally toothed

Nº 227,198



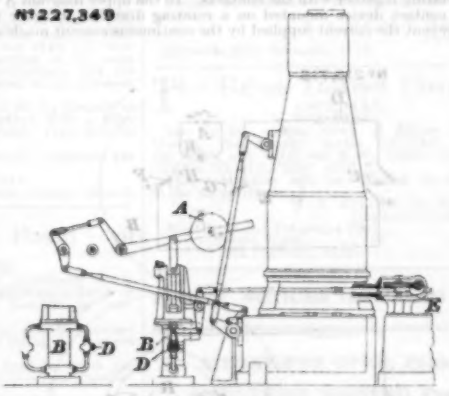
wheel B and the two are mounted in a machine for giving them a relative reciprocating motion. The teeth are kept in contact with one another by means of a spring device C and the wheel is moved around in relation to the lap, occasionally, so as to minimise inequalities. An abrasive is, of course, used to provide a cutting effect.—*January* 12*th*, 1925.

CRANES AND CONVEYORS.

227,349. May 27th, 1924.—EMERGENCY BRAKES FOR WINDING ENGINES, W. T. Bell and F. B. Perry, Robey and Co., Limited, Lincoln.

This gear is intended to check excessive speed in winding, gradually during the general period of the wind, and also to check it quickly, if the speed should be abnormal towards the end of the wind, in order to prevent overwinding. The mechanism is more or less normal in that the braking engine is set in action when a weight A is released by a trip gear controlled by

Nº 227,349



a governor. The speed at which the weight falls, and consequently the abruptness of the braking action, is determined by the oil dashpot B. There are two oil passages for this dashpot, which are controlled by cocks C and D. One cock is adjusted to give a normal braking effect when the other cock is closed. The second cock is connected with a cam E worked by the depth indicator and is opened towards the end of the wind, so that, in the event of the trip gear acting, the dashpot will have a free passage for the oil and the brake will be applied rapidly.—*January* 15*th*, 1925.

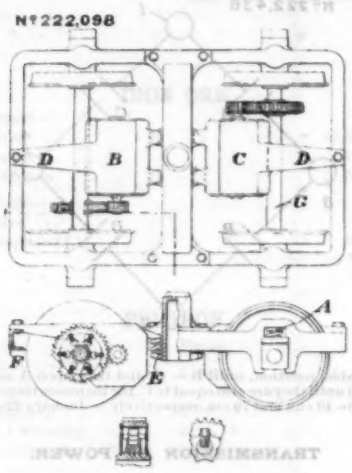
TRAMWAYS AND RAILWAYS.

223,098. August 27th, 1924.—IMPROVEMENTS RELATING TO MOTOR SUSPENSION SYSTEMS FOR ELECTRIC LOCOMOTIVES AND OTHER ELECTRICALLY PROPELLED VEHICLES, *Metropolitan-Vickers Electrical Company, A, Central Buildings, Westminster.*

The truck frame is mounted on springs A. A pair of motors

B and C have extending arms D and are mounted on springs E. Each arm portion is secured to the corresponding timber frame F by a screw or bolt. The motors drive the axles by pinion and gear wheels as shown. The gear wheels are of spiral con-

No 222,098



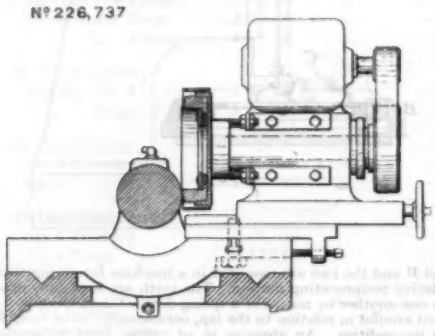
struction and form the subject of a previous patent. The flexible construction of the gear wheels permits of relative movement of the motor axle and truck frame members without affecting the gear tooth engagement between the wheels and pinions.—*January* 15*th*, 1925.

MISCELLANEOUS.

226,737. June 10th, 1924.—GRINDING ROLLS FOR CEREALS, L. Schmidt, 1222, South Eighth-street, St. Louis, Missouri.

This invention aims at improving the efficiency of break rolls in the reduction of cereals, such as the grinding of wheat to produce flour. The inventor comments on the disadvantages of the usual methods of increasing the grip of the rolls on the grain,

No 226,737

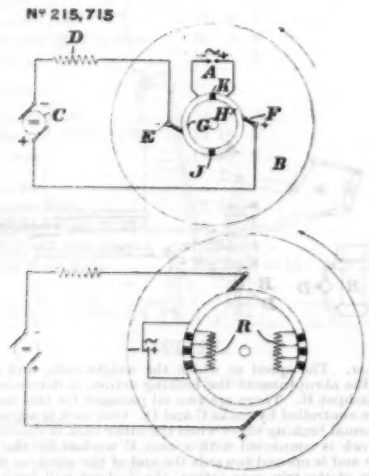


and puts forward a process of grinding their surface so that the scratch marks produced in grinding are more or less parallel with their axis, instead of being circumferential as heretofore. The illustration shows the general arrangement of a machine for grinding the rolls according to the inventor's ideas.—*January* 1*st*, 1925.

215,715. January 10th, 1924.—AN IMPROVED ROTARY ELECTRIC CONTACT DEVICE, C. Lorenz Aktiengesellschaft, of Lorenzwig, Berlin, Tempelhof, Germany.

This specification describes a contact device which is connected to a source of continuous current and in which the continuous current led to the rotating contacts is converted into alternating current through the intermediary of a commutator rotating together with the contacts. In the upper diagram A is a contact device mounted on a rotating disc B. In order to prevent the current supplied by the continuous current machine

No 215,715



C through the field D destroying the contacts, the current is led over the brushes E and F to the semi-circular segments G H, which are insulated from one another. The contact points at A are connected to these segments. Whilst the disc is rotating the direction of the arrow the brush E passes over the insulation K and the brush F over the insulation K and the segments G and H, and the two contact points A are charged in opposite directions. The lower illustration shows the same machine, but the segments in this case are separated by several pieces of insulation, and by using bridging resistances R it is possible gradually to balance the voltages between the main segments and thereby to prevent the formation of sparks when the brushes pass from one main segment to the other. The scheme is apparently intended for use in connection with regulating machines with rotating contacts, which, when operated, say, by centrifugal force, act upon a regulating member of the driving machine. The continuous current to be supplied to the rotating contacts is converted into alternating current in order to prevent wear on the contacts.—*January* 15*th*, 1925.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. Graduates' meeting. Paper, "Why Pneumatic Tires?" by Mr. R. Marks. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "A Treatise on Modern Lighting Practice," by Mr. E. Stroud. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society, Newcastle-upon-Tyne. Paper, "Ultimate Possibilities of Steam Plant," by Professor A. L. Mellanby and Dr. W. Kerr. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: MIDDLESBROUGH BRANCH.—Graduate Section's visit to the works of Bolckow, Vaughan and Co., South Bank.

PHYSICAL SOCIETY OF LONDON.—Imperial College of Science, South Kensington, London, S.W. 7. Papers, "Notes Concerning the Sprengel Pump," by Mr. J. J. Manley; "The Thomson Effect in Copper, Iron and Carbon Steels," by Mr. J. Young; "An Improved Cathode-ray Tube Method for the Harmonic Comparison of Frequencies and for the Delineation of their Wave Form," by Mr. D. W. Dye. 5 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Sugars from the Standpoint of the Organic Chemist," by Sir James Irvine. 9 p.m.

SATURDAY, FEBRUARY 28TH.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Graduate Section's visit to the works of the Tharsis Sulphur and Copper Company, Limited, Hebburn. 2.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Lecture, "The Counting of the Atoms, I.," by Sir Ernest Rutherford. 3 p.m.

MONDAY, MARCH 2ND.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lecture, "Modern Developments in Power Generation," by Mr. J. Townley. 7.30 p.m.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "The Manipulation of Exceptional Passenger Traffics," by Mr. E. C. Cox. 5.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-UPON-TYNE ASSOCIATION.—Neville Hall, Newcastle-upon-Tyne. Paper, "Construction of the Burnhope Intake and Pipe Line, and also the Stanhope Tunnel, for the Durham County Water Board," by Mr. H. Robinson. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: WESTERN CENTRE.—South Wales Institute of Engineers, Park-place, Cardiff. Paper, "The Drive of Power Station Auxiliaries," by Messrs. L. Breach and H. Midgley. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-WESTERN SECTION.—Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. "Power Factor Improvement," by Mr. G. H. Ayres. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's Gate, Westminster, London, S.W. 1. Annual lecture, "A Visit to America," by Mr. W. H. Patchell. 7 p.m.

ROYAL INSZITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. General meeting of members. 5 p.m.

SOCIETY OF ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "Notes on Preparing a Tender," by Mr. R. J. Money. 5.30 p.m.

TUESDAY, MARCH 3RD.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, London, E. 1. Paper, "Fuel Economy," by Mr. E. W. L. Nicol. 6.30 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street, Birmingham. Paper, "Slags and Fluxes: Their Composition and Uses," by Mr. J. H. Russell. 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. Paper, "Steam Pipes for Extra High Pressure and Temperature," by Mr. J. A. Aiton. 7.30 p.m.

WEST YORKSHIRE METALLURGICAL SOCIETY.—George Hotel, Huddersfield. Discussion, "The Connection between the Microstructure and the Mechanical Properties of Metals and Alloys." 7.30 p.m.

WEDNESDAY, MARCH 4TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Current Transformer Methods of Producing Small Known Voltages and Currents at Radio Frequencies for Calibrating Purposes," by Mr. D. Dye; and "The Measurement of Frequency and Allied Quantities in Wireless Telegraphy," by Lieut.-Colonel K. E. Edgworth and Lieut. G. W. N. Cobbold. 6 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—The Engineers' Club, Coventry-street, London, W. 1. Paper, "Water Softening in relation to Heating and Domestic Hot Water Supply," by Mr. W. B. Lewis. 7 p.m.

NEWCOMEN SOCIETY.—Prince Henry's Room, 17, Fleet-street, London, E.C. 4. Paper, "Gun Handicraft," by Mr. C. E. Greener. 5.30 p.m.

THURSDAY, MARCH 5TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. "The Post Office and Automatic Telephones," by Colonel T. F. Purves. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—7, Albemarle-street, Piccadilly, London, W. 1. Paper, "Some Medical Aspects of Air Transport," by Lieutenant-Colonel C. H. Heald. 5.30 p.m.

FRIDAY, MARCH 6TH.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, Leeds. Annual dinner. 6.30 for 6.45 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Pitfalls for Patentees." 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "How to Apply for a Job, and How Not to Do It," by Mr. E. Fianders Etchells. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "The Rate of Man's Evolution," by Sir Arthur Keith. 9 p.m.

SATURDAY, MARCH 7TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Ealing, London, W. 5.—Joint meeting of the Eastern and South Midland Districts. 2.15 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Lecture, "The Counting of the Atoms—II.," by Sir Ernest Rutherford. 3 p.m.

MONDAY, MARCH 9TH.

CHADWICK PUBLIC LECTURE.—Inner Temple Hall, London. "The Necessity for Legislation with Regard to Smoke Abatement," by The Lord Newton. 8 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Paper, "Electric Furnaces," by Mr. A. Glynne Lobley. 7.30 p.m.

TUESDAY, MARCH 10TH.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—37, Elmbank-crescent, Glasgow. Paper, "The Manufacture of Brass Condenser Tubes, with some Notes on an Alternative Alloy," by Messrs. G. A. Whiteman and A. Spittle. 7.30 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Annual general meeting. Address by Mr. H. Barringer, the retiring President. 5.30 p.m.

WEDNESDAY AND THURSDAY, MARCH 11TH AND 12TH.

INSTITUTE OF METALS.—Institution of Mechanical Engineers, Storey's Gate, London, S.W. 1. Annual general meeting. For programme, see page 233. 10 a.m. each day.

FRIDAY, MARCH 13TH.

EX-BRITISH WESTINGHOUSE ASSOCIATION.—Holborn Restaurant, London, W.C. 1. Seventh annual re-union dinner. 6.45 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department of the University, Singleton Park, Swansea. General discussion. 7.15 p.m.

JUNIOR INSTITUTION OF ENGINEERS, 39, Victoria-street, London, S.W. 1. Lecturette, "Notes on Methods of Producing Modern High-grade Machine Tools," by Mr. A. P. Bale. 7.30 p.m.

MONDAY, MARCH 16TH.

INSTITUTION OF STRUCTURAL ENGINEERS.—Criterion Restaurant, Piccadilly, London, W. 1. Annual dinner. 7 for 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-WESTERN SECTION.—Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. "Industrial Electric Vehicles," by Mr. J. R. Oliver. 7.15 p.m.

WOMEN'S ELECTRICAL ASSOCIATION.—Visit to the Osram Lamp Works, Hammersmith. 2.30 p.m.

TUESDAY, MARCH 17TH.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, London, E. 1. Paper, "Motor Passenger Vessels," by Mr. A. C. Hardy. 6.30 p.m.

WEDNESDAY, MARCH 18TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Theatre, Armstrong College, Newcastle-on-Tyne. Paper, "Electric Furnaces," by Mr. A. Glynne Lobley. 7.30 p.m.

THE INSTITUTION OF ELECTRICAL ENGINEERS: ASSOCIATE MEMBERSHIP EXAMINATION.—The Council of the Institution of Electrical Engineers has decided to accept, in lieu of Part I. of the A.M.I.E.E. examination, the higher grade National Certificate or Diploma in Electrical Engineering, provided the candidate satisfies the Institution in the subject of "English Essay."

LIFT AND CRANE MAKERS' ASSOCIATION.—A general meeting of lift, hoist and crane makers will shortly be held, under the auspices of the Council of the recently formed Lift and Crane Makers' Association, for the purpose of considering and approving rules, appointing officials and other important objects. All members of the trade who have not heard direct from the secretary may communicate with him, care of Hawkin, Smalley and Co., 1, Mitre-court-buildings, Temple, E.C. 4, which is the address of the Association. The date, place and agenda of the general trade meeting will, on application to the secretary, be communicated to those wishing to attend.

THE SCIENCE MUSEUM.—The Board of Education has just issued a new catalogue, which Mr. W. H. Dickinson has compiled, of the stationary engine exhibits in the Science Museum at South Kensington. Under the energetic management which now prevails, the Science Museum is one of the greatest educational establishments in the world. People who are unacquainted with it imagine that it is only of historical value, and that nothing which is not antique can be found within its walls. That is far from the truth, for the object of the directors is to display the full sequence of invention from the past to the present, and examples or models of the newest products of the engineer and technician are to be found there. Take but a single example, quite at random. There is a series of sixteen different kinds of lock-nuts and lock-washers, including some that are less than five years old. The catalogue before us, like those that have preceded it, is far more than a mere list of exhibits. It contains copious explanatory notes, prepared with great skill, and anyone who could pass an examination on it would have gone far to acquiring that fundamental knowledge of machines which is at the root of mechanical engineering.